Livestock Data Innovation in Africa

INVESTING IN THE LIVESTOCK SECTOR

Why Good Numbers Matter

A Sourcebook for Decision Makers on How to Improve Livestock Data

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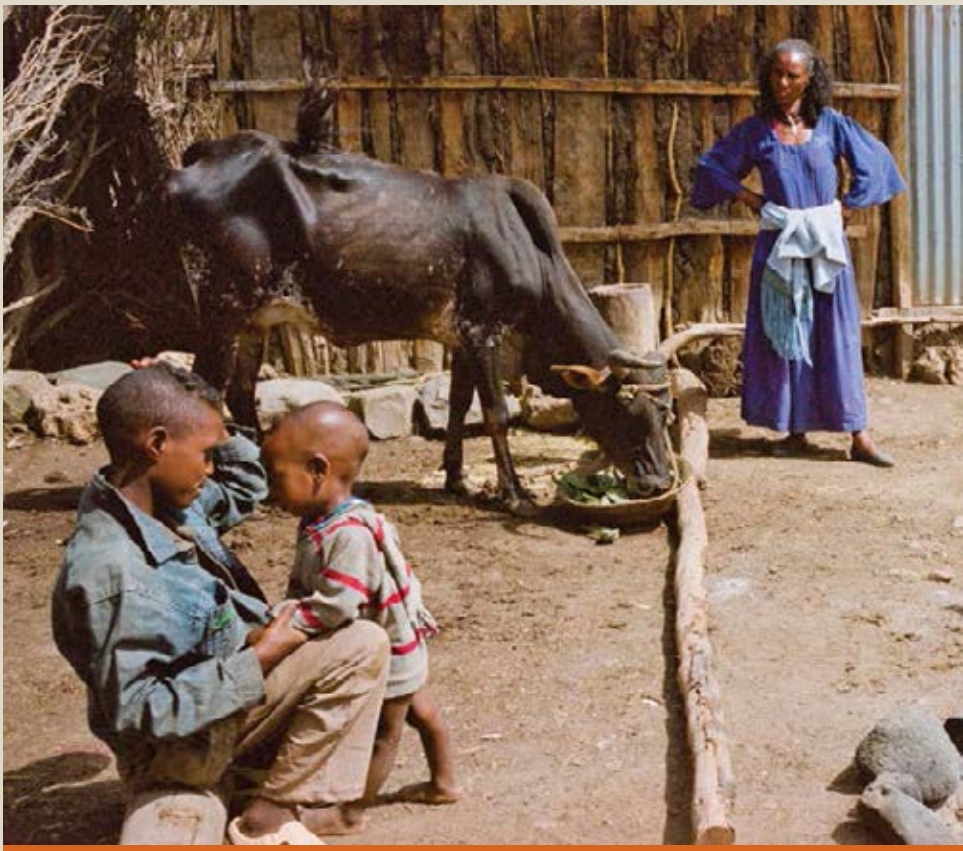

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PREFACE

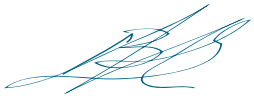
Limited access to quality data is a major constraint to economic development, making it difficult for public and private actors to design and implement policies and investments which maximize economic growth while being smallholder inclusive. This is overwhelmingly the case for agriculture, where output is generated by a series of inputs directly controlled by the producer, which are often difficult to measure, but also influenced by a series of variables beyond his control, such as temperature and rainfall. Within agriculture, livestock is a key sector which poses considerable challenges for collecting data, and hence designing effective policies and investments. As far back as 1957, the Chief of the Agriculture Division of the US Bureau of the Census, Dr. Ray Hurley, observed: *"in analysing the [US] census experience covering 16 nationwide censuses and almost 120 years, one concludes that the nationwide collection of satisfactory livestock data ... is a difficult task and involves a number of problems. Even the job of obtaining a count of livestock is fraught with difficulties. Livestock numbers change every day of the year. Marketing is a continuous process. Livestock inventories are affected by births, deaths, farm slaughter, and by growth and change in age of animals"* (Hurley, 1957, pp. 1420–1).

Recognizing that stakeholders contend that data availability which feed into evidence based livestock policies and investments is inadequate and fragmented, the World Bank, the FAO, the International Livestock Research Institute (ILRI) and the African Union — Interafrican Bureau for Animal Resources (AU-IBAR), with financial support from the Bill & Melinda Gates Foundation (BMGF), implemented the *Livestock in Africa: Improving Data for Better Policies* Project. The Project, implemented between 2010–2013 in collaboration with the pilot countries of Uganda, Tanzania and Niger, targeted an improvement of the quantity and quality of the livestock information available to decision makers through enhanced methods for data collection and analysis within the context of the overall agricultural statistical system.

This Sourcebook summarizes the outputs and lessons of the *Livestock in Africa: Improving Data for Better Policies* Project. It aims to present the challenges facing professionals collecting and analysing livestock data and statistics and possible solutions. While the Sourcebook does not address all conceivable issues related to enhancing livestock data and underlining statistical issues, it does represent a unique document for a number of reasons. To begin with, it is possibly the first document which specifically addresses the broad complexity of livestock data collection, taking into consideration the unique characteristics of the sector. Indeed, in most cases livestock data are dealt with, if ever, within the context of major agricultural initiatives. Second, the Sourcebook is a joint product of users and suppliers of livestock data, with its overarching objective being to respond to the information needs of data users, and primarily the Ministries responsible for livestock in African countries and the National Statistical Authorities. Finally, the Sourcebook represents a unique experiment of inter-institutional collaboration, which jointly places the World Bank, the FAO Animal Production and Health Division, the ILRI and the Africa Union — Interafrican Bureau for Animal Resources as well as national governments in Niger, Tanzania and Uganda at the forefront of data and statistical innovation for evidence-based livestock sector policies and investments.

This Sourcebook represents a first step towards a demand-driven and sustainable approach to enhance the livestock information available to decision makers. It is hoped it will provide a useable framework for significantly improving the quantity and quality of livestock data and statistics available to the public and private sector, and also increase the efficacy of investments that country governments and the international community allocate to generate information for livestock sector policies and investments.

World Bank | Juergen Voegele, Director, Agriculture and Environmental Services Department



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ABBREVIATIONS AND ACRONYMS

AI	Artificial Insemination
AMD	Average Milk per Day
AU-IBAR	African Union — Interafrican Bureau for Animal Resources
BMGF	Bill & Melinda Gates Foundation
CAADP	Comprehensive Africa Agriculture Development Programme
CBPP	Contagious Bovine Pleuropneumonia
CCPP	Contagious Caprine Pleuropneumonia
CCT	CAADP Country Team
CIRAD	Agricultural Research for Development
CPI	Consumer Price Index
EA	Enumeration Area
EPA	Enquête Permanente Agricole, Burkina Faso
FAO	Food and Agriculture Organization of the United Nations
FMD	Food and Mouth Disease
GDP	Gross Domestic Product
ILRI	International Livestock Research Institute
ISN	Institut National de la Statistique, Niger
JICA	Japan International Cooperation Agency
LC	Lactation Curve
LDIP	Livestock Data Innovation in Africa Project
LID	Livestock in Development
LSD	Lumpy Skin Disease
LSMS	Living Standards Measurement Study
LSMS-ISA	Living Standards Measurement Study — Integrated Surveys on Agriculture
LU	Livestock Unit
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries, Uganda
MEL	Ministère de Élevage, Niger
MLF	Ministry of Livestock and Fisheries, Zanzibar
MLFD	Ministry of Livestock and Fisheries Development, Tanzania
NDVI	Normalized Difference Vegetation Index
NBS	National Bureau of Statistics, Tanzania
NCD	Newcastle Disease
NDVI	Normalized Difference Vegetation Index
NGO	Non-governmental Organization
NLC	National Livestock Census
NPS	National Panel Survey
OECD	Organization for Economic Co-operation and Development
OiE	World Organization for Animal Health
SAE	Small Area Estimation
TCF	Technical Conversion Factor
TLU	Tropical Livestock Unit
UBOS	Uganda Bureau of Statistics
UNFPA	United Nations Population Fund
UNLC	Uganda National Livestock Census

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INTRODUCTION

The growing demand for food of animal origin in developing countries, stimulated by population growth, gains in real per capita income, and urbanization, represents a major opportunity for poverty reduction, economic growth, and overall contribution to the post-2015 Development Agenda (Delgado *et al.,* 1999).

This is particularly the case for Africa where aggregate economic growth of over 5 percent per year over the period 2000–2013 has exceeded growth rates in many other world regions due to consolidated macroeconomic and political stability throughout the continent. Robust economic growth in Africa has been and is anticipated to translate into a growing demand for animal-source foods. Meat and dairy products are high-value food products for which consumption is well correlated with income level. In 2005/07, the average African citizen consumed about 11 kilos of meat per year and 35 liters of milk. This is projected to progressively increase in the coming decades, up to 26 kilos and 64 liters in 2050 respectively (Pica-Ciamarra *et al.*, 2013).

These projections are notable, but definitely more striking if one considers that by 2050 the African population will be 2.2 billion, more than doubling its 2005/07 level (0.9 billion). Overall, between 2005/07 and 2050 total milk consumption will increase from 32 to 83 million tons (+159%), and total meat consumption from 11 to 35 million tons (+218%). At constant farm-gate prices, the total market value of meat products will increase from US$ 33 to US$ 108 billion (+227%), and that of milk from US$ 17 to US$ 44 (+158%) (Nouala *et al.,* 2011; Pica-Ciamarra *et al.*, 2013).

Available data on livestock, stakeholders contend, are insufficient to formulate and implement the necessary public and private sector investments for livestock sector development, whose potential contributions to economic growth, poverty reduction and food security risk thus remain untapped. Most countries *"lack the capacity to produce and report even the minimum set of agricultural data necessary to monitor national trends or inform the international development debate"* (World Bank, 2011, p. 11). In particular, a review of existing livestock-related data/datasets for African countries suggests that:

- There exists a variety of livestock-related indicators within Africa at country level, including figures on animal numbers and meat and dairy production, consumption, and trade flows of a number of livestock products, both raw and processed (e.g. FAOSTAT, 2013; WAHIS, 2013). The quality of available data, however, is often questioned by livestock stakeholders, even for the most basic indicators such as livestock numbers (see chapter 1.4).
- Nationally representative household, agricultural and/or farm surveys — which are more or less regularly undertaken by the National Statistical Authorities — tend to marginally appreciate livestock. The survey questionnaires contain only a few, if any, livestock-related questions, mainly focusing on the number of animals owned and value of production. These surveys, therefore, don't currently lend themselves to generating comprehensive information on farm, non-farm and off-farm livestock-related activities (e.g. on livestock trade), which is much needed by policy makers (see chapter 1.3).
- Specialized livestock surveys are rarely undertaken by national governments. These surveys typically target technical issues — such as animal breeds, feed, animal diseases, meat production, etc. — with an ultimate objective of better understanding the determinants of livestock production and productivity. They represent a critical input for the design of effective policies and investments at farm level (see chapter 1.4).
- National governments collect on a regular basis data on animal diseases which, if uncontrolled, may cause major economic and social losses. However, the quality of the collected data, including their timing and accuracy, is uncertain. This limits the capacity of the government to effectively control and manage the spread of diseases, including zoonoses (Okello *et al.*, 2013).
- Finally, all sources of livestock data and statistics — such as agricultural censuses, livestock censuses, periodical and *ad hoc* agricultural sample surveys, household income or expenditure surveys — rarely if ever generate comprehensive information on pastoral production systems, which is of considerable relevance to many African countries, particularly those in the Sahel and the Horn of Africa (see chapter 1.4).

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To sum up, livestock data are not widely collected by national governments and rarely on a regular basis; and the quality of available data is mixed in its timeliness, completeness, comparability and accuracy. This makes it difficult the design and implementation of effective investments and policies in the sector.

Over the past decades a number of initiatives have been launched to support the collection and analysis of agricultural data and statistics, including the Partnership in Statistics for Development in the 21st Century (PARIS21), the Wye Group on Statistics on Rural Development and Agriculture Household Income, the UN *Global Strategy to Improve Agricultural and Rural Statistics* (World Bank, 2011), and the 2010–2013 *Livestock in Africa: Improving Data for Better Policies* Project. The latter, jointly implemented by the African Union — Interafrican Bureau for Animal Resources (AU-IBAR), the Food and Agriculture Organization (FAO), the International Livestock Research Institute (ILRI), the World Bank, and the national governments of Niger, Tanzania and Uganda, is possibly one of the first attempts to specifically address livestock data and statistical issues in Africa.

This Sourcebook on livestock data summarizes the activities and outputs of the *Livestock in Africa: Improving Data for Better Policies* Project. It provides guidance to decision makers responsible to collect and analyze livestock data from different perspectives on how to systematically address livestock data-related issues within the context of the national agricultural statistical system. In particular, it first develops the skeleton of a sound livestock statistical system — consistent with the demand of livestock information by stakeholders and the principles of the *Global Strategy to Improve Agricultural and Rural Statistics* (World Bank, 2011) — which represents the foundation for producing good livestock data. It then presents a sample of methods and tools – and associated examples — designed to improve the quantity and quality of livestock data available to decision makers. These tools and methods target household and farm level data — for example, trade data and the role of expert informants to generate statistics are not dealt with in the Sourcebook — and to a large extent have been tested in the context of the implementation of Living Standards Measurement Studies and small-scale data collection exercises in Niger, Tanzania and Uganda. They were jointly identified and developed based on dialogue between the *Livestock in Africa: Improving Data for Better Policies* Project and users and suppliers of livestock data and statistics at country level, including the Ministry responsible for livestock development, the National Statistical Authority, and other national and pan-African public and private sector data stakeholders. As such, they address data issues which are of broad interest to livestock stakeholders: the 23rd session of the African Commission for Agricultural Statistics (AFCAS, December 2013) recommended country governments in the continent adopt some of the tools and methods presented in the following chapters to improve the quantity and quality of the livestock information available to decision makers.

PART I of the Sourcebook reviews the demand and supply of livestock data. It first presents the principles underpinning an effective agricultural and livestock statistical system, such as presented in the *Global Strategy to Improve Agricultural and Rural Statistics* (chapter 1.1). It then identifies the core livestock indicators needed by decision makers, not only for regular monitoring and planning (chapter 1.2) but also for policy and investment purposes (chapter 1.3). It finally investigates whether the prevailing agricultural data collection systems suffice to generate these indicators (chapter 1.4). In most cases the answer to this question is no, or only to a limited extent.

PART II presents tools and methods on how to improve livestock statistical systems, including the quantity and quality of livestock data. It proposes a livestock module for integrated household or agricultural surveys, which consists of a set of questions aimed at revealing the full role of livestock in the household and the farm economy (chapter 2.1); it reviews experiments in survey design, including one on milk production and one on pastoralist livelihoods, which provide guidance on how to develop or improve the content of household or farm level survey questionnaires (chapter 2.2); it addresses approaches to better estimate livestock technical conversion factors, and hence livestock production (chapter 2.3), and presents an institutional approach to improve the quality of routine livestock data or administrative records, which are a major source of information on animal diseases in the country (chapter 2.4).

PART III provides some practical evidence on how country governments produce or could produce some selected livestock indicators for the proper formulation of policies and investments. Chapter 3.1 highlights options for estimating livestock population in and in-between surveys, with examples from West Africa. Chapter 3.2 discusses how, using data from the implementation of the livestock module for

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multi-topic household surveys, the contribution of livestock to household livelihoods can be properly assessed and feed into the design of policies and investments that maximize the impact of sector growth to the broader goal of poverty reduction. Chapter 3.3, 3.4 and 3.5 bring to light that livestock data from most surveys — even when an effective agricultural statistical system is in place — are insufficient on their own to provide detailed guidance to investors and policy makers and present methods to fill this information gap. Chapter 3.3 gives an example of data integration to obtain statistically robust measures of the contribution of livestock to household income at district level in Uganda, by jointly using data from the 2008 Uganda Livestock Census and the 2009/10 Uganda Panel Survey. Chapter 3.4 presents and discusses the implementation in Tanzania and Uganda of a methodology to collect data on the quality dimensions of the market for animal-sourced foods. This information is not captured by quantitative data, but it is essential to assess the opportunities for a demand-driven growth of the livestock sector which is inclusive of smallholder producers' participation. Finally, Chapter 3.5 reveals that available data are usually sufficient to identify broad categories of symptoms of constraints to livestock production and productivity, but do not suffice to provide clear guidance for policies and investments. It then presents a methodology, implemented and tested in Uganda and Tanzania, which helps mapping symptoms with a structured list of core constraints at farm level, thereby assisting decision makers in identifying priority areas for investments to increase livestock production and productivity.

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PART I.
DEMAND AND SUPPLY OF LIVESTOCK DATA: GAPS AND ISSUES

1.1 THE BASICS OF A PROPER LIVESTOCK STATISTICAL SYSTEM

KEY MESSAGES

Good livestock data originate from a functional agricultural statistical system.

A wide number of livestock data users require a multitude of data, but the agricultural statistical system should prioritize a minimum set of core data as the building block of good livestock statistics.

Data integration, i.e. the use of data originating from different livestock, agricultural and non-agricultural surveys, is essential for the design of effective sector policies and investments.

Good governance, institutional collaboration and capacity building are critical ingredients of a functional agricultural statistical system, which also includes livestock.

THE ISSUE

About 60 percent of rural households in developing countries are partially or fully dependent on livestock for their livelihoods. Livestock rearing provides them with a wide spectrum of benefits, such as cash income, food, manure, draft power and hauling services, savings and insurance, and social status. The livestock sector currently accounts for about one-third of agricultural value added in developing countries, and for over half of the value added in industrialized economies (FAOSTAT, 2013). While livestock farming might also have some negative effects on society, through animal-human disease transmission and environmental impacts, the sector remains critically important for millions of people in developing countries (Otte *et al.*, 2012).

The livestock sector, and the role that animals play in the household economy in developing countries, are anticipated to change rapidly in the coming decades. Consumers, including those in sub-Saharan Africa, are increasingly demanding high-value agricultural products such as fruit, vegetables, meat, and dairy products (Delgado *et al.*, 1999; Pica-Ciamarra *et al.*, 2013; Jabbar *et al.*, 2010). Producers will respond to this growing demand and, as a consequence, livestock will become an increasingly important sector of agriculture.

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"Data not only measures progress, it inspires it."

HILLARY R. CLINTON

In this fast-changing context, good quality livestock data are needed for designing and implementing policies and investments that sustain and promote the sector's socially desirable development. Available livestock data, and the derived statistics or indicators, however, are largely considered inadequate for effective decision making.

Perry and Sones (2009) present a review of major databases targeting livestock and conclude that *"often available data is not adequate to answer the questions being raised or to allow optimal targeting or design of interventions. Available data is patchy, often old, disparate, scattered and hard to combine and pull together. Even seemingly mundane and basic data, such as accurate estimates of the number of poultry in a country, are often unobtainable, let alone more complex questions such as what is the impact of a given disease"*.

A Report on Livestock Data and Information in Tanzania released in 2010 by the Ministry of Livestock and Fisheries Development reads: *"Livestock data are currently inadequate in Tanzania … as they lack consistency through time and between sources; and are not complete as they possess a lot of gaps"* (MLFD, 2010b).

In 1999, LID produced a report on 'Livestock in Poverty-Focused Development': it estimated that about 70 percent of the rural poor, about 970 million people, were dependent on livestock for part of their livelihoods (LID, 1999). Ten years later, in 2009, the FAO State of Food and Agriculture 'Livestock in the Balance' (FAO, 2009), touching on the livestock and poverty equation, duplicated the table produced by LID, clearly illustrating that livestock poverty data are not updated regularly.

A National Livestock Census undertaken in Uganda in 2008 estimated the cattle population at 11.4 million. The day before the Census release, the national herd stood at 7.5 million cattle. In other words, overnight the Census increased the cattle population in the country by 3.9 million heads, with pre-census data underestimating it by 52 percent (MAAIF and UBOS, 2009). The budgetary implications for the Uganda Ministry responsible for animal resources cannot be overstated.

The estimation of livestock value added in the national accounts makes use of so-called technical conversion factors. These are coefficients that convert a measured livestock variable into a different unit of measure: for example, 'milk yield per cow per day' allows estimating milk production by only counting the number of milking cows in the country. In Tanzania, the livestock technical conversion factors used to estimate the livestock value added in the national accounts have been kept constant for over ten years, i.e. all possible increases in livestock productivity achieved in recent years are not captured in the official country statistics (MLFD, 2012).

The above examples, and others available from developing countries, highlight that livestock sector investments and policy decisions are often based on inadequate information, which results in a less than optimal allocation of scarce public resources. Investments that improve the quantity and quality of livestock data can thus generate handsome returns in the medium to long-term, provided they produce the information needed by decision makers to make evidence-based decisions for sector development.

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LIVESTOCK IN THE *GLOBAL STRATEGY TO IMPROVE AGRICULTURAL AND RURAL STATISTICS*

Livestock is part of agriculture; livestock data are part of agricultural data. Indeed, livestock is usually a component of agricultural surveys, with countries seldom undertaking standalone livestock surveys. Improving the quantity and quality of livestock data available to decision makers requires, therefore, improving the functioning of the agricultural statistical system which, in turn, is part of the national statistical system.

The Global Strategy to Improve Agricultural and Rural Statistics (Global Strategy), endorsed by the UN Statistical Commission in 2010, provides broad guidance on how to improve the agricultural statistical system, and livestock data therein (World Bank, 2011). The *Global Strategy* recommends targeting investments to improve agricultural and rural statistics around three pillars:

1. The establishment of a minimum set of core data that country governments should collect on a regular basis;
2. The integration of agriculture into the national statistical system;
3. Governance and statistical capacity building.

PILLAR 1 *Establishing a minimum set of core livestock data*

Different stakeholders demand a variety of data and indicators for a multitude of purposes, which all too often exceed the production capabilities of the national statistical system. The *Global Strategy* recommends that the starting point for the improvement of agricultural and rural statistics be the identification of a core set of data to be regularly collected. These core data, selected for their importance to agriculture, should target the social, the productive and the environmental dimensions of the sector. They will provide inputs to develop several indicators/statistics, including the national accounts and the balances of supply and demand for food and other agricultural products.

The *Global Strategy* identifies five core livestock items from which data should be collected, namely cattle; sheep; pigs; goats; and poultry. For these items, the *Global Strategy* urges the collection of the following core data as a minimum: inventory and annual births; level of production; imports and exports; and producer and consumer prices. The *Global Strategy* also recommends that country governments should check the consistency of the suggested core items and data with their own information needs and, in some cases, add additional items and data.

PILLAR 2 *Integrating livestock into the national statistical system*

Several governmental organizations/agencies collect and use agricultural data. These include, for example, the National Statistical Office, the Ministry responsible for animal resources; the Dairy/Meat Board; the Ministry of Trade, and others. These actors often collect the same data, but because of little coordination, end up producing indicators that are incomparable, or even conflicting in some circumstances. There are several reasons for this, such as the use of different sampling units and/or different samples; different concepts, definitions and classifications; different methods of data collection; different questionnaires; and other.

The *Global Strategy* recommends that country governments develop a unique master sample frame for agriculture. The frame is the means by which the statistical units to be enumerated in the collection are identified, such as a list of all rural households or agricultural holdings, identifying each unit without omissions or duplication. A unique master sample will provide the basis for the selection of samples of farms or households for all surveys, which allows linking farm and household characteristics and connecting both to the land cover and use dimensions. The "area sample" frame — which is essentially the country land mass divided into sampling units — is deemed appropriate to this purpose. The

"The Global Strategy recommends that country governments develop a unique master sample frame for agriculture. The frame is the means by which the statistical units to be enumerated in the collection are identified."

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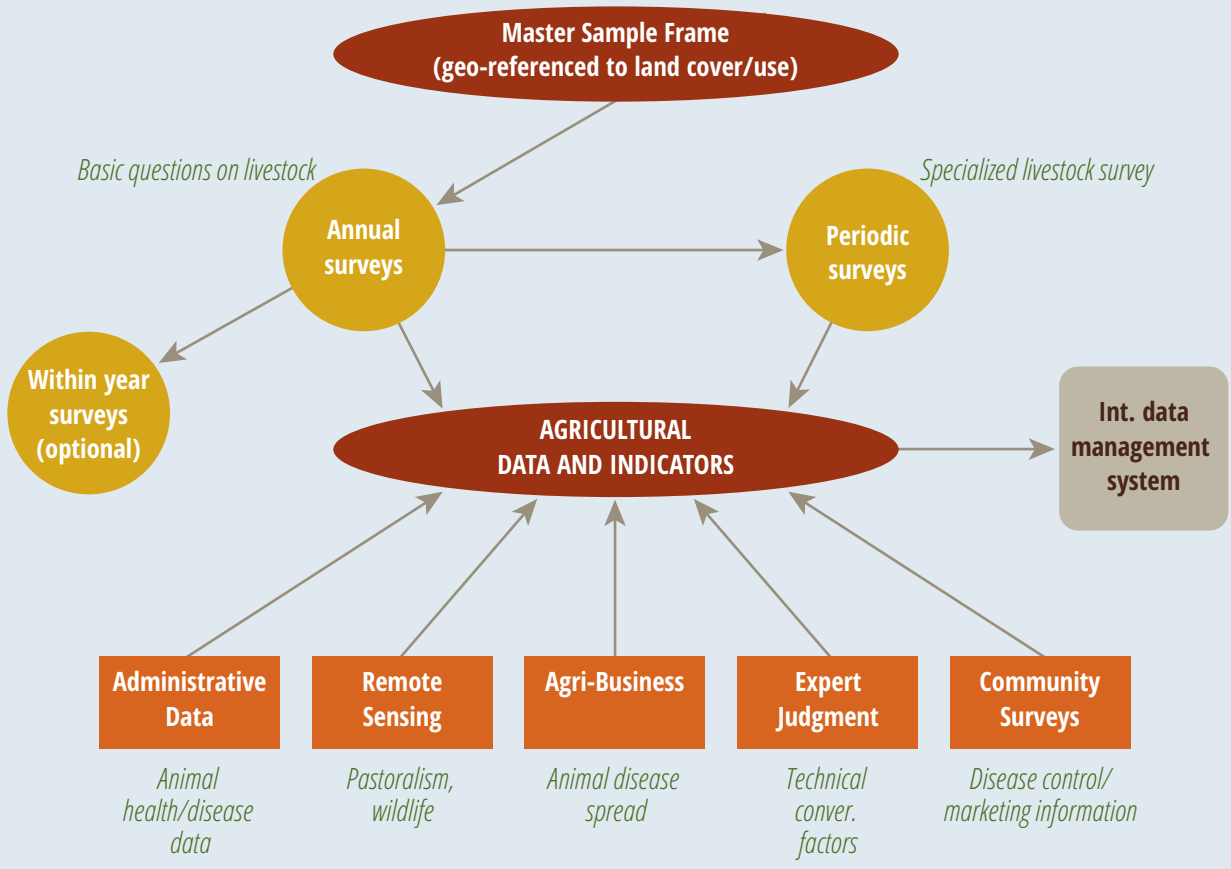
"Using common classifications, concepts and definitions is critical to facilitate the use of data from different surveys."

adoption of a unique master sample for agriculture ensures that data from different surveys, including standalone livestock surveys, can be combined and jointly analyzed, thereby facilitating the appreciation of livestock's role in the micro and macro economy. A unique master sample frame demonstrates its value when an integrated survey framework (Figure 1) is developed and when data collectors use common classifications, concepts and definitions. An integrated survey framework ensures that, with no duplication and at minimum cost, all core data, and additional needed data, can be collected as demanded by stakeholders. As to livestock, the integrated survey framework could include, for instance, a light annual agricultural survey with basic questions on livestock; a specialized survey administered every other year collecting detailed data on the livestock sector; administrative records and community surveys used to collect data on animal diseases on a monthly basis; remote sensing surveys to count animals in pastoral areas at regular year interval; and expert judgments used to estimate and regularly update livestock technical conversion factors.

Using common classifications, concepts and definitions is critical to facilitating the use of data from the different surveys included in the integrated survey framework. For example, milking animals could be defined variously as all females in reproductive ages, or as females bred especially for milk production and actually milked during the reference period. Furthermore, milk production could be gross, which includes the milk sold and that suckled by young animals, or net, which

FIGURE 1. THE INTEGRATED SURVEY FRAMEWORK: A FOCUS ON LIVESTOCK



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excludes milk suckled by young animals. Alternatively, meat production could be quantified as dressed carcass weight, gross carcass weight (including the hide or skin, head, feet and internal organs, but excluding the part of the blood which is not collected in the course of slaughter), or live weight (FAO, 2000). As far as possible, countries should make use of the FAOSTAT Commodity List, which provides an international classification for agriculture commodities, including live animals and livestock primary and processed products.

PILLAR 3 *Governance and capacity building*

Multiples organizations are involved in the collection and analysis of agricultural data, including livestock data. A functional statistical system requires that the roles and responsibilities of all actors be clear and agreed upon; that common concepts, standards and classifications are used; that samples are drawn from the sample master frame; and that there is no duplication of efforts, as all data collection systems will find their logical place in the integrated survey framework.

Data from livestock are collected not only by the National Statistical Office but also by other institutions, such as the Ministry responsible for animal resources, the Meat and Dairy Board, the Ministry of Industry, and the Ministry of Trade. It follows that any improvement in the quantity and quality of livestock data should involve not only the National Statistical Authority but also other actors, which require targeted statistical capacity building. On the other hand, the Statistical Authority would need to appreciate the peculiar characteristics of livestock, a pre-condition for ensuring that livestock is adequately represented in statistical surveys.

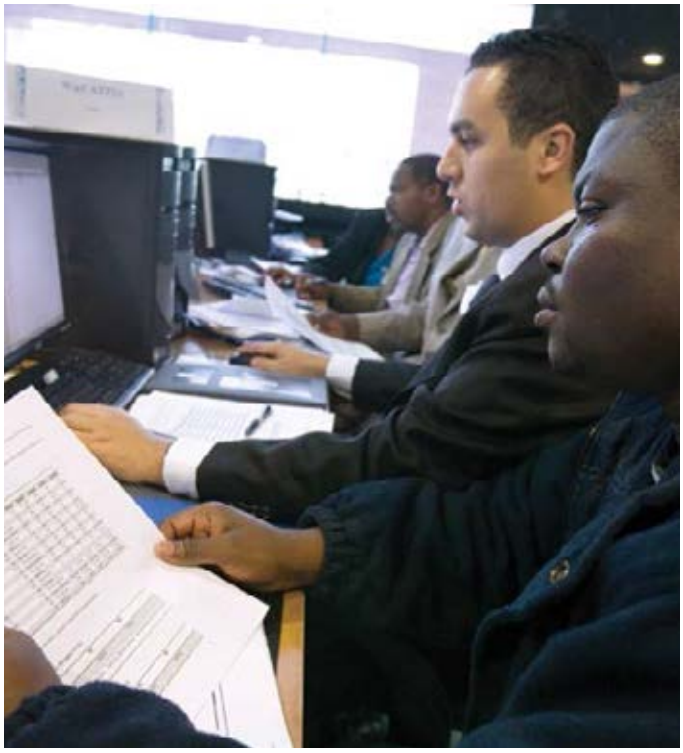
Implementing the Global Strategy

The *Global Strategy to Improve Agricultural and Rural Statistics* is implemented through a Global Action Plan which, in turn, is articulated in regional plans, including one for Africa. The Global Action Plan includes three major components: research, technical assistance, and capacity building. The research component aims at developing technical guidelines and handbooks on methodologies, standards and tools related to the pillars of the *Global Strategy*. Technical assistance is country specific and aims at assisting country governments in designing agricultural sector statistics plans and establishing the governance structure underpinning a functional agricultural statistical system. Capacity building involves the improvement of statistical capacity at the country level to ensure that countries successfully implement the *Global Strategy*.

THE SPECIFICITIES OF THE LIVESTOCK SECTOR

While improving the agricultural system is a pre-requisite to improve the quantity and quality of livestock data, the proper measuring of livestock requires addressing some unique sector characteristics.

> Back in 1957 Hurley observed: *"in analysing the [US] census experience covering 16 nationwide censuses and almost 120 years, one concludes that the nationwide collection of satisfactory livestock data … is a difficult task and involves a number of problems. Even the job of obtaining a count of livestock is fraught with difficulties. Livestock numbers change every day of the year. Marketing is a continuous process. Livestock inventories are affected by births, deaths, farm slaughter, and by growth and change in age of animals"* (Hurley, 1957, pp. 1420–1).



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While there are infinite issues to address in successfully assessing livestock, from a data collection perspective there are ultimately three broad areas that should receive attention: sampling; animal biology (zoology) and production systems; and animal health/diseases.

- **Sampling:** The presence of animals across space depends on a variety of factors, such as agro-ecological conditions and animal movements, which means the spatial distribution of livestock changes throughout the year and is somewhat uncorrelated to that of rural households and farm holdings, which are the typical sampling units. Selecting appropriate sampling points, appropriate samples and sample weights, and identifying the right time for any survey also targeting livestock can be therefore challenging, but it is critical for producing reliable livestock sector statistics.
- **Animal biology and production systems:** Animals' life cycles are affected by the way they are raised, i.e. by the production system. Measuring the latter is challenging when rural households — rather than commercial enterprises — keep animals, as these do not regularly record inputs and outputs along the production process. In these circumstances, a number of data-related issues need to be addressed before any livestock data collection starts. For example:
  - Which is the appropriate recall period for survey questions on the number of animals, given that species have different life cycles?
  - How to assess the grade of the animals, considering, for instance, that the monetary value of a herd of thin cattle differ from that of one of well-fed animals?
  - How to formulate survey questions on animal diseases? Should one follow an etiological or a symptomatic approach? Are household or community surveys the most appropriate survey tool?
  - How to quantify labor input, and hence labor productivity, when the herder manages a mixed herd, e.g. when s/he jointly takes different animals to water points?
  - How to measure the quantity of forage available from roadside hedges, often a major source of animal feed?
  - How to ask milk production questions, so as to also measure the quantity of milk suckled by calves?
  - How to quantify manure production in traditional production systems and how to value it?
  - Other, such as measuring poultry meat production at farm level, or the value of the transport and draught services provided by animals.
- **Animal health/diseases:** The *Global Strategy* notes that *"understanding the demand for statistical information at the national level [...] is a key element of the sustainability of an agricultural statistics system. Demand can be supported and strengthened if the statistical system is responsive to users and provides statistics that are relevant, accessible, timely, and with a level of accuracy that meets their needs"* (World Bank, 2011, p. 27). Regarding livestock, stakeholders demand a variety of indicators (see chapter 2 and 3 in World Bank 2011), among which animal health/disease data require special attention for three reasons. First, the Ministry responsible for animal resources typically allocates a large, if not the largest, part of its resources to the management and control of epidemic and zoonotic diseases. Second, the Ministry itself often collects animal health/disease data, i.e. it is both a supplier and user of animal health data. Finally, country governments have international obligations to regularly report on their animal disease situation to the World Organisation for Animal Health (OiE) — including immediate notification (within 48 hours) of an outbreak of an OiE-listed disease. In Africa, they must also send monthly reports on their animal disease status to the African Union – Interafrican Bureau for Animal Resources (AU-IBAR). A statistical system that responds to users' needs, therefore, must be able to ensure the collection of timely and reliable animal health/disease data.

"What we measure affects what we do; and if our measurements are flawed, decisions may be distorted."

STIGLITZ COMMISSION ON THE MEASUREMENT OF ECONOMIC PERFORMANCE AND SOCIAL PROGRESS, 2010

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CONCLUSIONS

In the coming decades, the livestock sector is anticipated to grow rapidly in developing countries. This provides both opportunities and challenges, which are best dealt with through good quality livestock data and indicators. However, there is evidence that current agricultural data and indicators — including livestock data — are often inadequate, which prevents the design of effective policies and investment in the sector.

As recommended by the *Global Strategy to Improve Agricultural and Rural Statistics*, country governments should invest resources to improve the agricultural statistical system, starting with identifying a minimum set of core data; developing an integrated survey framework; and ensuring cross-institutional collaboration. At the same time, some livestock-specific data issues need to be addressed for the agricultural data system to generate sufficient good quality livestock data, as livestock present peculiar characteristics that require *ad hoc* methods and approaches to data collection that need to be developed and implemented. The next three chapters in the Sourcebook assess the demand for and availability of livestock data, with the objective of identifying the major information gaps facing livestock stakeholders. Chapter 1.2 identifies the core livestock data and indicators that decision makers need on a regular basis to fulfil their mandate. Chapter 1.3 presents the information that decision makers need for policy and investment purposes, linking it to the various phases of the policy process, from agenda setting to policy implementation. Finally, chapter 1.4 examines whether the prevailing agricultural data collection systems suffice to satisfy the data demands of livestock stakeholders and identifies priority information gaps.

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1.2 CORE LIVESTOCK DATA AND INDICATORS

KEY MESSAGES

Core livestock data of critical importance identified by the *Global Strategy to Improve Agricultural and Rural Statistics* include: 1) animal numbers and births; 2) production of animal products; 3) trade statistics; and 4) producer and consumer prices.

Livestock stakeholders recommend including animal disease-related data in the core data, such as number of animals vaccinated and outbreaks of animal diseases. These data are essential for the Ministry responsible for livestock which, to fulfill its mandate, allocates a large share of its budget to control and manage animal diseases.

The needs of livestock data users require that the institutions involved in the collection of livestock data provide statistics at different levels of aggregation and with different time frequency.

"We, the Ministers responsible for Animal Resources in Africa… urge Member States to enhance capacity for timely collection, analysis and sharing of quality data to guide policy, strategy and investment programmes."

AFRICAN UNION, 2010

AS MANY LIVESTOCK INDICATORS AS LIVESTOCK STAKEHOLDERS

A multitude of stakeholders make use of livestock data and indicators for a variety of purposes. Stakeholders include government ministries and other public or quasi-public agencies, such as dairy boards and statistical authorities; the private sector, encompassing small, medium and large scale livestock producers as well as input suppliers, traders, consumers and other actors along the value chain; livestock researchers and scientists in national, regional and international institutions; the civil society, such as NGOs, trade unions and indigenous peoples movements; international organizations and the donor community.

Livestock stakeholders have different objectives and look for different statistics, in terms of data items, variables, level of representativeness and time dimension. For instance, while indicators on livestock population and its trend at national level are of primary importance for the Ministry responsible for animal resources, these are of limited relevance for small or medium scale producers; while traders look for daily information on market prices of live animals and livestock products in terminal markets, this information is of little use to epidemiologists; while national governments, international organizations and the donor community have interest in accessing indicators on the incidence and distribution of poverty, including on poor livestock keepers, these statistics are of marginal, if any, significance for consumers.

Stakeholders are mostly dissatisfied with the quantity and quality of available livestock data and indicators (World Bank, 2011). Public investments are thus called for to enhance their quantity and quality. However, any attempt to improve the agricultural statistical system so that good data and indicators are provided to all livestock stakeholders as per each stakeholder's specific needs is destined to fail.

First, there are many stakeholders with a numerous information needs, i.e. thousands of indicators should be produced to satisfy their demand for information. Second, while some data and indicators are public goods, many others are private goods: these should not be generated by the public sector but by private actors with their own resources. Third, some

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indicators are needed only in specific circumstances, and it would be inefficient to generate them regularly within the context of the agricultural statistical system, i.e. *ad hoc* data collection exercises should be undertaken in these cases. Examples could be indicators on the nutritional value of raw milk, which are of use when a nutrition policy is formulated; or on the breed traits of local animals, which are largely static. Finally, the public sector acts on budget constraints, which prevent the establishment of a comprehensive agricultural statistical system capable of generating all conceivable livestock-related indicators.

CORE LIVESTOCK DATA AND INDICATORS IN THE *GLOBAL STRATEGY TO IMPROVE AGRICULTURAL AND RURAL STATSTICS*

The *Global Strategy* recommends that a *"minimum set of core data is to be used as a starting point"* to improve the agricultural statistical system. These core data should target three major dimensions of agriculture, namely the social, the production and the environmental dimensions. The livestock sector falls under the production dimension and the *Global Strategy* identifies five core livestock items for which indicators are to be generated (World Bank, 2011, p. 14):

- Cattle;
- Sheep;
- Pigs;
- Goats;
- Poultry.

These items were selected because of their importance to livestock production globally: they contribute to over 99 percent of meat, milk and eggs production, with the remaining coming from animals such as camels, yaks, rabbits and equines (FAOSTAT, 2013). For the above items, the *Global Strategy* (World Bank, 2011, p. 14) identifies the following core data:

- Inventory and annual births;
- Production of products such as meat, milk, eggs, and wool, and net trade or imports and exports;
- Producer and consumer prices.

These data would help in the estimation of the two major livestock indicators identified in the *Global Strategy* (World Bank, 2011, p. 34), namely:

- Livestock value added — a critical component of the Gross Domestic Product — for the calculation of which data are needed on animal population, production level and use of inputs;
- Changes in components of livestock and poultry population by species, which encompasses data on trends in the livestock population and herd composition by gender, age and purpose (e.g. for breeding or fattening).

Before embarking in any effort to improve agricultural data systems, country governments — recommends the *Global Strategy* — should check the consistency of the suggested core items and data with their own information needs and, in case, add additional items and data. Camels and alpacas, for instance, could be a livestock item for Sahelian and Andean countries respectively. National governments are also recommended to determine how frequently data for the core items should be collected and associated indicators generated.

PRIORITY LIVESTOCK INFORMATION NEEDS IN SUB-SAHARAN AFRICA

The FAO-World Bank-ILRI-AU-IBAR *Livestock in Africa: Improving Data for Better Policies* Project undertook four online surveys — two global and two targeting Ugandan and Tanzanian stakeholders respectively — and sponsored two international workshop in East Africa to better appreciate the information needs of livestock stakeholders and, in particular, of the National Statistical Authority and the Ministry responsible for animal resources (LDIA, 2011a, 2011b, 2011e; Pica-Ciamarra and Baker, 2011; Pica-Ciamarra *et al.*, 2012). The latter are the major actors in livestock data collection and statistics dissemination in developing countries, and any improvement in systems of livestock data collection should first target their priority information needs (MLFD and LDIP, 2011). Only then will these institutions will be willing to invest resources to collect and produce other livestock data and indicators to meet their additional information needs and/or the demands of other stakeholders.

Priority information needs are here defined as the set of data and indicators that the National Statistical Authority and the

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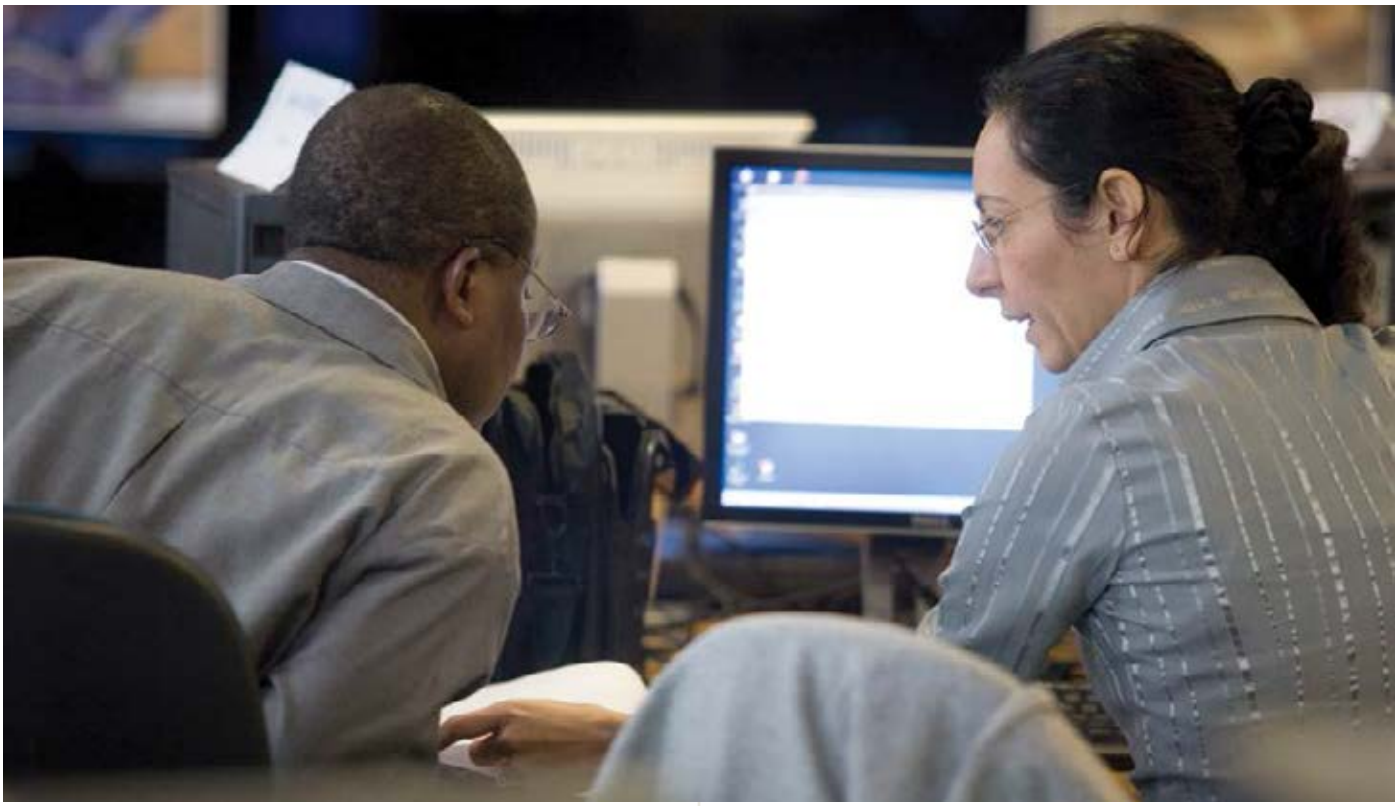

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Ministry responsible for livestock development require on a regular basis to properly fulfil their mandate, i.e. those data and indicators that are essential to deliver their monthly, quarterly and annual outputs, and whose generation is typically funded through the recurrent expenditure in their annual budget. Information needed on a larger frequency or irregularly is not considered a priority, even though it may well be of critical importance for livestock stakeholders.

Priority livestock information needs for the National Statistical Authority

The National Statistical Authority is mandated to ensure the production and dissemination of reliable statistics in a variety of domains — e.g. social, economic and environment statistics — in order to meet the information needs of data stakeholders, including the government. This involves the administration of censuses and sample surveys; analysis of data and dissemination of statistics and statistical reports; the promotion of a coordinated, harmonized and efficient national statistical system; and training and guidance to other providers and users of statistics.

"CPI is the most relevant measure of the cost of living in all countries and its trend is used to calculate the inflation rate, a major target of monetary policies."

While the National Statistical Authority has a broad mandate, its priority livestock information targets the production of two major indicators, which it generates and disseminates at least once per quarter. These are:

- The Consumer Price Index (CPI);
- The Gross Domestic Product (GDP).

CPI is estimated monthly and is one of the several price indices calculated by the National Statistical Authority. It is the most relevant measure of the cost of living in all countries and its trend is used to calculate the inflation rate, a major target of monetary policies. It is also used as a price deflator in the compilation of real economic statistics, such as GDP at constant prices.

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CPI is a weighted average of prices of a representative basket of consumer goods and services, such as food and non-alcoholic beverages; housing water, clothing and footwear; electricity, gas and other fuels; health; transport; etc. Weights are (should be) updated every five years at least, based on budget/expenditure survey data. The food basket, which includes animal-source foods, is a major component of CPI. Prices are usually collected by data collectors in a sample of outlets in rural and urban areas (ILO, 2004).

GDP is the market value of all final goods and services produced in a country and its trend is a major indicator of growth in the economy. Most countries calculate GDP using the so-called production approach, which is basically the difference between the value of outputs for all sectors less the value of goods and services used in producing those outputs over the reference period. This is the so-called 'value added'. In developing countries, livestock value added is a relevant component of the GDP. GDP estimates are released by the National Statistical Authority quarterly and annually.

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Priority livestock information needs for the Ministry responsible for animal resources

The Ministry responsible for animal resources has the overall mandate to promote, regulate and facilitate the sustainable development of the livestock sector in the country. This involves the formulation, implementation and monitoring and evaluation of sector programs and policies, as well as the delivery of public services and goods, such as vaccinations against epidemic diseases. To fulfill its mandate, the Ministry requires a variety of information, but three set of indicators have been identified as the most needed, namely:

- Animal disease-related indicators, e.g. number and proportion of animals affected by a certain epidemic disease, number of animals at risk of infection, number of animals vaccinated against selected diseases, etc.;
- Indicators on animal population, e.g. number of animals by species, breeds, sex and age over a reference period;
- Production and productivity-related indicators, e.g. level of beef production per year and milk yield per cow.

In most countries, as Chapter 1.1 noted, the Ministry mandated for livestock development allocates a large share of its resources to animal health-related activities. For instance, over 26 percent of the recurrent expenditure of the Tanzania Ministry of Livestock and Fisheries Development is used for this purpose, according to the Medium Term Expenditure Framework 2010/11 – 2012/13 (MLFD, 2010a). The fundamental reason is that the Ministry is responsible for managing and controlling epidemic and zoonotic diseases, and particularly to intervene as rapidly as possible when there are outbreaks, in order to avoid disease spread and the associated socio-economic losses. In addition, country governments have international obligations to regularly report on their animal disease situation to the World Organisation for Animal Health (OiE) — including immediate notification (within 48 hours) of outbreaks of an OiE listed disease. In Africa, country governments must also send monthly reports on their animal health status to the African Union – Interafrican Bureau for Animal Resources (AU-IBAR).

Detection of animal disease outbreaks is of limited value on its own for the Ministry: updated information on the livestock population in the affected area, and beyond, is essential for designing effective interventions and budgeting them properly. Preventive vaccination or stamping out, for

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example, are best implemented when the number of animals at risk and those (potentially) infected by a certain disease are known with some statistical precision. Indicators on the livestock population, and its distribution across the country, are also essential for the Ministry to deliver public goods and services and formulate sector policies and programs.

Finally, the Ministry responsible for animal resources does need with some regularity, at a minimum once per year, indicators on livestock production and productivity, which are a major piece of information for monitoring and evaluating the effects of most interventions on the ground.

CORE LIVESTOCK INDICATORS IN SUB-SAHARAN AFRICA

The priority information needs by the National Statistical Authority and the Ministry responsible for livestock helps identify the core livestock indicators for sub-Saharan African countries and, more in general, for developing countries as a whole, including frequency and level of representativeness. These are presented in Table 1 and discussed below.

1. Livestock value added

Livestock value added is a critical component of GDP. Its calculation requires (i) data on total number of animals and changes in the number of animals — which can be treated either as fixed capital (e.g. breeding animals) or as 'work in progress' animals (e.g. for slaughter) — over the reference period; (ii) on production of livestock products, such as meat of various types, milk, eggs, hides & skins, manure, etc; (iii) on the inputs used in the production process, such as animal feed/fodder and water; animal health services, vaccines, medicines and dips; fuel and electricity; repairs and maintenance; (iv) on imports and exports of live animals and livestock products; (v) on output and input prices. Outputs are valued at farm-gate prices that reflect the value of goods for the producers; inputs are valued at purchaser's prices, i.e. the prices that are effectively paid by the producers (see Box 1 and LDIP 2012a). This information is needed on a quarterly basis at a minimum. Data from nationally representative sample surveys suffice for estimating livestock value added, as GDP is presented for the country as a whole and, in some circumstances, for its major regions.

TABLE 1. CORE LIVESTOCK INDICATORS FOR SUB-SAHARAN AFRICA

	INDICATORS	FREQUENCY	LEVEL OF REPRESENTATIVENESS
1	Livestock value added	Quarterly; Annually	Country; Major-regions
2	Average market prices for live animals and livestock products	Quarterly; Annually	Country; Major-regions
3	Outbreaks of animal diseases; Number of animals affected; Number of animals at risk.	Immediately after disease outbreaks; Monthly	District or lower administrative level
4	Total number of live animals	Quarterly; Annually	District or lower administrative level
5	Total production quantity of major livestock products	Annually	Country; Major-regions

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BOX 1. LIVESTOCK'S CONTRIBUTION TO GROSS DOMESTIC PRODUCT

The size of livestock's contribution to agricultural value added as well as to the gross domestic product (GDP), is a commonly quoted measure of livestock's role in the national economy. In all countries, GDP is estimated at least quarterly and annually by national statistical authorities. There are three ways of calculating GDP, which include the production approach, the expenditure approach and the income approach. All should lead to the same result. The production approach quantifies the difference between the value of outputs for all sectors less the value of goods and services used in producing those outputs during one year, i.e. it quantifies the so-called 'value added' for all sectors in the economy. The income approach measures the incomes of all individuals living in the economy over the reference year; the expenditure approach quantifies all expenditures by all individuals living in the country in the accounting period. Most country governments estimate GDP using the production approach. This method allows for measuring the overall performance of the economy as well as that of each productive sector (e.g. livestock) and of specific enterprises within each sector (e.g. beef and poultry). It also allows for tracking changes in the structure of the economy and within sectors. Values added at constant prices are useful to estimate growth rates/performances of the economy as a whole or of sector/sub-sectors over time; values added at current prices are useful for analyses of structural changes in the economy and within sectors.

Value added is defined as the value of the output of a sector minus the value of all intermediate inputs. It is calculated without making deductions for depreciation of fixed assets and depletion/degradation of natural resources. Outputs from the livestock sector include the increase in the number of animals and the production of livestock products. The increase in number of animals is represented by both fixed capital formation – i.e. animals that are inputs into the production process, such as breeding animals and adult males for breeding or animal traction – and by so-called 'work-in progress' animals, namely those reared for slaughter and young animals reared to become fixed assets. Livestock products include meat, milk, eggs, and other by-products, such as manure, hides and skins, fat, offals, honey, transport services, etc. Intermediate inputs comprise animal feed/fodder and water; animal health services, vaccines, medicines and dips; fuel and electricity; repairs and maintenance, such as fences and equipment, etc. Outputs are valued at so-called basic prices, i.e. farm-gate prices that reflect the value of goods for the producers. Intermediate inputs are valued at the purchaser's prices, i.e. the prices that are effectively paid by the producers. ■

2. Average market prices for live animals and for major livestock products

Average retail market prices, including for live animals, animal-source foods and livestock by-products are needed for the National Statistical Authority to produce the CPI. Quarterly data, representative of the country and of its major regions, suffice to produce CPI.

3. Outbreaks of select animal diseases; number of animals affected; number of animals at risk.

These indicators are essential for the Ministry to control and manage the spread of epidemic and/or zoonotic diseases, i.e. to identify outbreaks; treat and destroy animals; and to vaccinate those at risk and/or control animal movement. In addition, countries must report outbreaks of selected diseases within 48 hours to OiE, send monthly animal-disease reports to IBAR, and six-monthly and an annual report to OiE (OiE, 2011). These reports contain detailed information on disease outbreaks, with information on latitude and longitude and first administrative division, and actions taken to monitor and control the outbreak's spread.

4. Total number of live animals by major species at district or lower administrative level.

These indicators are critical for the Ministry responsible for livestock not only for efficient interventions when animal disease outbreaks occur but also for the Ministry or Local Governments to supply other goods and services — such as the construction and maintenance of market facilities or the administration of vaccines against Foot and Mouth disease — and to design sector policies and programs, such as on animal health or water for livestock. Quarterly data are preferred, as this allows monitoring changes in the livestock population, inclusive of large and small animals.

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5. Total quantity of production for major livestock products.

Information on production levels is critical to monitor trends in the sector and, combined with indicators on animal populations, it allows the generation of basic productivity indicators, such as milk yield per cow or eggs per laying hen. Production and productivity indicators, as said, are the basics to measure the performance of whatever intervention undertaken by the Ministry or other livestock stakeholders. Annual data for the country as whole and its macro-regions are typically sufficient.

CONCLUSIONS

There are few core livestock indicators for sub-Saharan African countries, defined as those needed monthly, quarterly and annually by either the National Statistical Authority or the Ministry responsible for livestock, and which should be generated through the recurrent expenditure budget. These are livestock value added, average market prices for live animals and livestock products; outbreaks of selected animal diseases, number of animals affected, number of animal at risk; total number of live animals by main species at district or lower administrative level; total quantity of production for major livestock products.

- Livestock value added contains, in principle, almost all information needed to monitor sector trends, particularly as it is released quarterly and annually. However, it does not include data on animal diseases, which are critical for the Ministry of Livestock. The details and precision with which countries estimate livestock value added vary, e.g. some may differentiate between local and exotic breeds of cattle and some not; some may include manure as one of the outputs of livestock, some others may not.
- Data needed to estimate the livestock value added, including on animal population, are of little use for the Ministry responsible for animal resources if collected, as in most of the cases, from sample surveys. Indeed, to deliver its services the Ministry needs indicators on the distribution of the livestock population at district or lower administrative level.
- Animal health indicators are of interest only to the Ministry of livestock and should be regularly collected at district or lower administrative level.
- While the core indicators for the Statistical Authority should be representative of the country as a whole and of major regions, the population and animal disease-related core indicators for the Ministry responsible for animal resources should be representative at district or lower administrative level.
- The National Statistical Authority demands data on a quarterly and annual basis. The Ministry of Livestock needs data more frequently, often on a monthly basis.
- The identified core data and indicators correspond to those in the *Global Strategy*, with the relevant exception of animal disease-related indicators that are not mentioned therein.

Investments aimed at improving livestock data systems in sub-Saharan African countries should first assess the prevailing agricultural (and livestock) data collection systems to evaluate whether they generate enough data to produce the identified core indicators. If this is not the case, then investments should be made to strengthen the production of such indicators (Chapter 1.4 presents a critical review of the prevailing agricultural and livestock data collection system in sub-Saharan Africa). It is also worth noting, however, that the availability of core livestock data and indicators is not sufficient for the statistical system to provide all the information needed by stakeholders to effectively design and implement livestock sector policies and investments. The latter should be based on a much wider set of data and indicators, many of which are not to be generated on a regular basis. The next chapter explores the kind of information needed for making effective evidence-based livestock sector policies and investments.

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1.3 DATA AND INDICATORS FOR EVIDENCE-BASED LIVESTOCK POLICIES AND INVESTMENTS

KEY MESSAGES

Different data and indicators are needed throughout the various phases of the policy process, from agenda setting through policy and investment design to implementation.

The statistical system provides enough information to broadly depict the livestock sector, including major trends, opportunities and constraints of different segments of producers.

The statistical system should provide all information needed to design and implement livestock sector policies and investments. Country governments need to allocate resources for *ad hoc* data collection when the time comes to design and implement interventions in the livestock sector.

"What we measure affects what we do; and if our measurements are flawed, decisions may be distorted."

Stiglitz Commission on the Measurement of Economic Performance and Social Progress, 2010

INTRODUCTION

The core livestock indicators identified in the previous chapter are, on their own, insufficient to provide adequate information for the proper design of livestock sector policies and investments. Indeed, so-called evidence-based policies and investments require a wider spectrum of data and indicators – e.g. the number of cattle keepers and their average herd; the seasonality of feed available and feed quality; marketing facilities and animal health posts along marketing routes; etc. They also need to be based on participatory and inclusive policy processes and, in many circumstances, on some *ex ante* pilots, primarily to test on a relatively small scale the effects of prospective interventions by comparing outcomes for those (households, communities, etc.) who participate in a given program against those who do not.

A larger set of good-quality data and indicators, participatory decision processes and *ex ante* pilots are complementary ways to enhance the quality and quantity of information for evidence-based policies and investments. The entry point for their usefulness, however, changes throughout the decision making process.

For example, good data are useful in identifying binding constraints to livestock productivity, and hence priority areas for investments; while *ex ante* pilots are more appropriate for identifying effective interventions to remove those constraints. This chapter systematizes the overall information needed by decision makers to effectively formulate and implement policies and investments in the livestock sector. It provides guidance on when and which data and indicators are needed in the policy/investment dialogue; when participatory decision making processes are most valuable; and when *ex ante* pilots are most appropriate.

It is recognized that the formulation and implementation of policies and investments is a continuous process and that many development partners condition the final outcome. For clarity, however, it is assumed here that the decision maker is the Ministry responsible for animal resources, and that the Ministry's overarching objective is the promotion

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of sustainable and inclusive growth in the livestock sector. Therefore, the Ministry should consider the following questions:

1. Why invest in livestock?

Allocating resources to the livestock sector makes sense only if its development contributes to the broader socio-economic development goals of the country. It is therefore necessary to understand the extent and nature of livestock's development contribution, both negative and positive.

2. Whom to target?

There is heterogeneity among livestock producers, and variety in their responses to changes in the economic and institutional infrastructure as determined by policy. Characterizing livestock producers is thus essential to formulate appropriate policies and investments. Identifying other benefactors from, and stakeholders in, livestock development is also valuable, particularly as conduits to value chain-based change.

3. Which constraints?

Identifying the binding constraints that prevent different types of livestock producers and stakeholders from making efficient use of their animals is indispensable in identifying priority areas for investment, and for policy reform. Such constraints can impede development in various ways, at local, national, regional and continental levels.

4. What to target?

Understanding and interpreting the root causes of binding constraints is necessary for the formulation of policies and investments that ease or eliminate those constraints, thereby allowing livestock producers and other stakeholders to capture all the potential benefits from livestock production and commerce.

5. How to design policies and investments?

Decision makers need to be informed of the pros and cons of alternative ways and means of easing and/or removing one or more binding constraints. This requires assembly and analysis of information in appropriate forms and formats.

6. How to ensure effective implementation?

Monitoring and evaluation are necessary to ensure that policies and investments be properly implemented and that the necessary adjustments can be made. This requires an information and analytic base that is iterative with the answers to the questions posed above.

The following sections address the above questions. The final section synthesizes the main points, focusing on the importance of accessing data and indicators, which provide a statistically precise picture of the country as a whole and of its major agro-ecological/administrative regions, a vital aspect for investment and policy design. This chapter does not specifically deal with the demand for information by the private sector, which is briefly discussed in the following box.

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BOX 2. UGANDA: THE DEMAND FOR INFORMATION OF A MILK PROCESSOR

The Sameer Agriculture & Livestock Ltd. (SALL) – a joint venture company established by the Sameer Group of Kenya in conjunction with RJ Corp. of India – took over of the former government parastatal Uganda Dairy Corporation in August 2006. Out of 39 large, medium and small dairy processing plants in Uganda, SALL is today the largest. SALL is manufacturer of the 'Fresh Dairy' range of dairy products. These include: fresh pasteurized milk; Ultra-Heat-Treatment (UHT) milk; yogurt; butter; ghee, and powder milk. Fresh pasteurized milk represents the major business for SALL, with about 45 to 50 percent of the milk processed daily used to produce pasteurized milk. About 30 to 40 percent of the processed milk goes into UHT milk, and the rest into the other dairy products.

SALL is a buyer of milk and a seller of dairy products. It largely buys from district cooperatives in Western and Central Uganda, which have established about 135 milk collection centers equipped with coolers and generators as well as testing kits provided by SALL. The milk is transported to the so-called Bulking Centers, managed by the Cooperatives, where it is chilled a second time. SALL insulated tankers then take the milk to the processing plant in Kampala.

Milk production in Uganda is insufficient to satisfy existing demand (the country is a net importer of milk) and SALL finds difficulties in getting sufficient and timely supply of milk (which leaves over 80 percent of its processing capacity unused). SALL has its own sources of information and, like all active companies, gets direct and indirect information on market status and trends through its business partners and through observing daily price trends. However, with the aim of expanding its operation and satisfying the unmet and growing demand for milk in Uganda, SALL would appreciate updated information on districts with relevant surplus production of milk as well as on potential trends of milk production in the country. Some of this information is available, but in most cases is either presented in formats which are of little use to SALL (e.g. only regional data are available or data are summarized in maps with no detail numbers attached) and based on data which are more than a few years old. Delayed availability of data is problematic in a country where, according to the Uganda Bureau of Statistics, annual GDP growth averaged over 7 percent over the past ten years, a growth which translates into changing consumers' food preferences and demand for livestock products. ■

WHY INVEST IN LIVESTOCK?

A pre-condition for investment in improved livestock data systems by the Ministry responsible for animal resources is access to adequate resources, through the Ministry of Finance or via other funding sources, such as the Regional Economic Communities, donors and financial partners, including the private sector. Access to such funds requires demonstrating that investment in livestock contributes to the overarching development goals of the country. Such contributions might relate to income generation and/or poverty reduction and food security, support enhanced resource use efficiency, and/or generate economic gains through stimulating trade. These contributions may also be regional in nature, such as the collective contribution to a goal like controlling animal disease. Success in generating investment funds to support sector development requires that the following question be answered.

In much of the developing world, a convincing answer to this question should provide evidence that the development of the livestock sector contributes to economic growth, poverty reduction, food security, reduced vulnerability and other socio-economic goals. To this end, the Ministry should be able to access and package for advocacy purposes the livestock-related and socio-economic data and indicators which reveal sector trends, shares in various aggregates, and their correlations with key socio-economic variables. Examples of such indicators are listed below; the figures are often more illustrative and compelling when comparing between countries.

- **Trends and projections in total and per-capita consumption of animal-source foods**, at country and regional level, and in specific locations or zones. This information could provide a rationale for supporting sustainable livestock sector growth in response to observed growth in demand for high-value foods, including animal-source foods.
- **Trends in livestock value added over the years**, in absolute terms and as proportion of agricultural value

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added and GDP. Given that the importance of livestock in agriculture tends to increase with economic development, this information could highlight that investments in the sector are needed to ensure its efficient and equitable growth.

- **Number and proportion of rural households keeping selected livestock species**, disaggregated by income, region, gender and other variables of development interest. Available data from developing countries show that, in most cases, the majority of rural dwellers keep livestock, which suggests that broad-based increases in livestock productivity could directly support their livelihoods, while also increasing the availability of animal protein to urban dwellers.
- **Rates of under-nutrition, daily per capita intake of meat and milk, and the proportion and section of the population not consuming animal-source foods**. These indicators could highlight the nutritional benefits available from increasing the availability of affordable livestock products.
- **Number and type of persons employed along selected livestock value chains**. This provides guidance on the potential for investments in the livestock sector to generate employment, which represents a major pathway out of poverty for the less well-off, amongst both urban and rural populations, and amongst vulnerable stakeholders such as women.

Simple data and indicators as the ones mentioned above can help make the case for investing in livestock. However, more powerful advocacy can be achieved by presenting rigorous statistical associations between livestock-based development and overall development. The following list of studies provides examples of such work, which requires high quality data that is standardized within or across countries. This list also supports the development and use of more advanced sets of indicators more geared to advocacy.

- In a seminal study on agricultural productivity differences across countries, Kawagoe *et al.* (1985) find that livestock — considered as an input representing long-run capital formation in the agricultural sector — is a significant determinant of agricultural production, as measured by gross output net of agricultural intermediate products.
- Bogale *et al.* (2005) look at the determinants of rural poverty in three Ethiopian districts, with poverty defined in terms of both per capita household calorific consumption and per capita household expenditure on basic needs. They show that the probability of a household being poor declines as the number of oxen owned increases.
- Benin *et al.* (2008) use an economy-wide model to estimate the responsiveness of the poverty rate to per capita agricultural GDP growth in Malawi. A one percent increase in livestock GDP per capita is anticipated to reduce national poverty by 0.34 percent.
- Pica *et al.* (2008) show that increases in livestock productivity — as measured by value added per Tropical Livestock Unit — appear to be/have been a cause of per capita GDP growth in 33 developing countries in Africa, Asia and Latin America.
- Bashir *et al.* (2012) estimate the contribution of livestock to food security in the State of Punjab, Pakistan, using data from 12 out of its 36 districts. Food secure households are defined as those with calorie intake at or above 2,450 Kcal/per capita/day. Results show that ownership of large and small ruminants has a positive impact on household food security.
- Otte *et al.* (2012) estimate household livestock income multipliers for major world regions, defined as the impact on total household income of a 1 US$ increase in either

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livestock production or livestock processing. Calculated multipliers range from 2.0 to 6.8, and are found to be larger than those associated with crops, fruits and vegetables, manufacturing and the service sector.

While basic data and indicators on livestock-related and socio-economic variables are available for most countries — though often not sufficiently disseminated or adequately analyzed — there are few examples of rigorous statistical analysis and modelled projections, and still fewer that can generate causality arguments to demonstrate the contribution of livestock to socio-economic development. This is partly because comprehensive datasets on livestock are not usually available — e.g. in most economy-wide models, livestock is included in the agriculture aggregate. At the same time, the Ministry responsible for livestock is not mandated, and often not equipped, to undertake such analyses. Nor does the Ministry typically have the power to influence significant change in data collection systems by national authorities, usually the national offices of statistics. However, it can collate and interpret existing documentation, including from neighbouring countries, and collaborate with regional, national and international research institutes to rigorously demonstrate that investing in livestock is an effective way to contribute to a number of socio-economic goals.

WHOM TO TARGET?

Once the Ministry responsible for livestock development demonstrates that livestock sector investments can contribute to some broad economic goal, and hence acquires resources to invest for sector development, the next relevant question to answer becomes:

Policies and investments are effective when they are consistent with the incentives of the livestock stakeholders, amongst which the producers are likely to be assigned some priority. The Ministry, therefore, needs information on current and emerging growth opportunities for animal-based food, the distinguishing characteristics of livestock producers and products, and on the prioritized use of animals in targeted households. Basic data and indicators that serve this purpose include:

- Trends in, and the form of, the demand for various animal-source foods, including unprocessed and processed products nationally and regionally;

"At present there is a serious paucity of statistical data on which to base marketing, investment, or policy decisions, or with which to assess the efficacy of current commitments or policies."

Global Strategy to Improve Agricultural and Rural Statistics, 2011

- Number of commercial livestock enterprises and number/share of rural households keeping farm animals;
- Herd size and herd composition of livestock producers;
- Livestock production per TLU and/or per unit of labor;
- Total income and share of total income derived from livestock for livestock-keeping households, disaggregated into rural/urban, male/female headed, and other variables of development interest;
- Level of livestock production, including shares of home consumption and marketed product, for livestock-keeping households.

These and other indicators should be used to identify a typology of producers, spanning the range from subsistence-oriented to specialized market-oriented livestock producers, through to large commercial farms. General typologies avoid *pre ante* targeting, which is often based on ethnic or other socio-cultural dimensions. Different typologies of producers keep livestock for different purposes, use a variety of technologies and respond uniquely to changes in the economic and institutional infrastructure, as determined by policy reforms within (and beyond) the sector. Such a typology has been proposed by Nouala *et al.* (2011):

- **Mixed subsistence-oriented livestock producers** are rural households that keep small herds, often mixing animals of different species; they sell a negligible part, if any, of their livestock production; and derive a relatively small share of their cash income from livestock. For them, any increase in livestock productivity — such as through

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reduction in animal mortality rate — has a positive impact on welfare.

- **Specialized market-oriented livestock producers** are rural households that keep a (relatively) homogenous herd — e.g. they could be specialized in milk or egg production — sell a significant share of their livestock production; and derive a significant part of their cash income from livestock. Improvements in livestock productivity for specialized market-oriented producers increase their cash income, assuming access to existing and growing market opportunities. These economic operators can also contribute to the generation of off-farm jobs along the value chain.
- **Commercial farms** are specialized enterprises: that maintain large homogenous herds, some permanent employees, and produce only for the market. Policies and investments to increase their productivity — such as reducing trade barriers to access inputs — make their business more profitable and competitive vis-à-vis imports. Increases in their efficiency could also potentially reduce the real price of animal-source foods in national markets — thus contributing to the food security of the (majority of) households that are net buyers of food — while generating a number of full time on- and off-farm jobs.

A variety of indicators can be used to define typologies of livestock farms — e.g. herd size and composition, husbandry practices, market participation, etc. Depending on the data available, countries may define their own typologies. While these data are useful, consultations with expert informants provide a complementary source of information on meaningful producer typologies. Indeed, data alone may generate typologies which are of little use to decision makers — e.g. a representative dairy farmer with 1.7 cows and selling 12 percent of the milk produced may be generated as an average taken across multiple modes in a dataset containing very few such individuals. A distinguishing element that in all cases should be taken into account is the household's motive for keeping farm animals, in particular whether it is related to subsistence or profit. This one factor will often condition the livestock producers' response to different types of policies and investments.

WHICH CONSTRAINTS?

Once typologies of livestock producers have been constructed, the challenge arises as to how to create opportunities for growth and the following question becomes relevant:

What are the critical and binding constraints that prevent the different livestock producers from making better use of their farm animals?

Policies and investments should attempt to relax or remove such constraints, particularly for key performance indicators such as livestock productivity, which limit the benefits that producers derive from their animals. Simple data and indicators on factors that are deemed to influence production and productivity provide preliminary information to decision makers. Examples are:

- Prevalence of selected animal diseases, i.e. proportion of small ruminants affected by goat plague (PPR, *Peste des Petits Ruminants*) over the reference period;
- Number and proportion of livestock producers with access to veterinary services; who regularly vaccinate their animals against selected diseases; who use de-wormers; who spray/dip animals against tick-borne diseases;
- Number and proportion of livestock producers feeding their animals with selected feeds or feed concentrates;
- Number and proportion of livestock producers with access to extension and financial services;
- Number and proportion of livestock producers who raise improved/exotic breeds;
- Number and proportion of livestock producers with social networks/capital such as membership in marketing cooperatives;
- Difference between farm-gate and retail-level prices for live animals and major livestock products;
- Number and types of livestock markets (e.g. primary, secondary), including location, frequency of operation and size;
- Access to common property resources, availability of forage, and sources and reliability of water used;

- Access to infrastructure such as roads and telecommunications;
- Number of processing plants, including potential and used capacity.

While levels, trends and shares of input-, output- and marketing-related variables provide relevant information to decision makers, more sophisticated analyses — which systematically link outputs and inputs — are critical to identify major determinants of production and productivity, and hence to point to binding constraints and priority areas for investment. Not undertaking this type of more detailed analysis often leads to investments that do not address critical constraints, thus minimizing the impact of overall investment. What follows are examples of multivariate analyses that attempted to identify the determinants of livestock production and productivity.

- Akter *et al.* (2003) examine the efficiency in poultry and pig production systems in Vietnam. Output is measured as value of production plus the change in inventory. For pigs, it was revealed that land size, herd size, education of household head and proximity to market are positively associated with efficiency. Conversely, the age of the household head, female-headed households, greater access to government supplied inputs, and higher proportion of family-supplied feed materials significantly increase inefficiency.
- Ishaq *et al.* (2007) find that, in the small ruminant system of Southern North West Frontier Province of Pakistan, expanding the herd size generates larger returns, in terms of milk production, than any other investment. In addition, the study indicates that doubling all inputs more than doubles total milk output.
- Ashagidigbi *et al.* (2011) examine the production and productivity of egg producers in Jos metropolis of Nigeria's Plateau State. They find that larger flock sizes and a reduction in the cost of drugs would lead to an increase in total production, as measured by the total number of eggs produced.
- Gelan and Muriithi (2012) assess the economic efficiency of 371 dairy farms in Kenya, Rwanda and Uganda. They show that the adaption of improved breeds in the herd and feed and fodder innovations have significant positive effects on the levels of economic efficiency. The latter is calculated as a function of total outputs (milk consumption, milk sales, animal sales and manure outputs) and total inputs (family and hired labor, fodder and feed, veterinary costs and other).
- Otieno *et al.* (2012) examine the determinants of technical efficiency in different beef production systems in four Kenyan districts. They conclude that the value of beef production would increase if farmers adopted controlled breeding methods; signed marketing contracts; hired farm managers; and if their off-farm income increased (due to its being invested in the cattle operation).

A critical challenge to formulating targeted interventions/investments that ensure development impact is the paucity of basic and comprehensive data and indicators on input-, output- and marketing-related variables. Consequently *ad hoc* data collection and participatory processes are essential to identify productivity constraints, but a review of existing work is also revealing. Such reviews find that, in general:

- When livestock data are available from household surveys, most subsistence-oriented livestock keepers are shown to lack access to even the simplest production inputs, such as animal health services and feed (Bocoum *et al.*, 2013; Covarrubias *et al.*, 2012). This implies that interventions that focus on ensuring access to basic inputs are a straightforward way to improve livelihoods through investments in livestock. Indeed, analyses that target subsistence-oriented livestock keepers invariably conclude that increases in the use of basic input— such as forage, feed and animal vaccines — significantly increase production.
- Analyses that target market-oriented specialized rural households and commercial enterprises typically conclude that increases in productivity (efficiency) could be triggered by dozens of different actions, many of which are beyond the control of the Ministry responsible for livestock (e.g. education, credit or year-around access to roads). This calls for collaboration among government agencies, public and private decision makers, and an agreement to use livestock as a catalyst for economic growth.

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WHAT TO TARGET?

Once there is information on whom to target (with a clear distinction of the intervention's objectives, i.e. supporting livelihoods or expanding the sector's contribution to economic growth), and on the binding constraints they face — e.g. limited access to veterinary services for subsistence-oriented livestock producers, or lack of credit for market-oriented livestock producers — the following area to explore is:

The identification of constraints and their subsequent prioritization, in practice, provides little guidance on how to relax and remove them, nor the sequencing of interventions that is required to induce positive change. For example, what can or should be done to ensure that farmers feed their animals with concentrates? How can the prevalence of selected animal diseases be reduced? How to promote the use of controlled breeding methods? In order to address the root causes of constraints, decision makers need a multitude of data and indicators. Indicators relevant to our example of feed concentrates, the use of which is anticipated to increase productivity, are:

- Availability of feed concentrates in rural markets;
- Number of feed producers and their productive capacity;
- Availability of pasture;
- Relative prices of feed concentrates to the products to be produced, including their seasonal fluctuations;
- Quality of available feed concentrates;
- Access to information on feed concentrates by livestock producers.

Summary statistics associated with a particular constraint or set of constraints, such as those listed above, help disentangle the root cause(s) of a constraint and, therefore, to better focus any prospective investment. Analyses that attempt to identify rigorously the root cause of a constraint provide

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additional information for better targeting interventions on the ground. Below are a few such examples of analyses:

- Jabbar *et al.* (2002) examine the supply and demand for livestock credit in Ethiopia, Kenya, Nigeria and Uganda. They find that gender of household head, education, training, prevalence of outstanding loan and the number of improved cattle on the farm, all have significant influence on household borrowing and liquidity.
- Ajuha *et al.* (2003) study the demand for veterinary services in three States of India, namely Gujarat, Rajasthan and Kerala. They show that in all the States the demand for veterinary services, as measured by the number of veterinary visits over the reference period, is negatively associated with the price of the services and positively associated with the service time, a quality indicator.
- Bahta and Bauer (2007) assess the determinants of market participation among small-scale livestock producers in the Free State Province of South Africa. Their results suggest that market information, distance to the preferred marketing outlet, level of training, access to extension services and livestock fertility rate all have positive impact on farmers' participation in livestock markets.
- Costales *et al.* (2008) study the factors that influence participation in contract farming of pig producers in Northern Vietnam. They conclude that level of education and large physical access holdings facilitate a farmer's engagement in formal contracts with large integrators.
- Achoja *et al.* (2010) examine the determinants of the demand for veterinary services by commercial poultry producers in the Delta State of Nigeria. They find that scale of production and distance to the nearest veterinary office significantly influence the use of veterinary services.

It is not feasible to access detailed information on all constraints affecting livestock producers in all locations and contexts of interest. Often, the most marginalized livestock systems offer the least amount of information. There are not, for example, readily available datasets with information on the quality of animal feeds in a long list of rural markets or on the price paid by farmers to vaccinate their animals. This makes it challenging to both present basic statistics and conduct analyses of constraints. In formulation of policies and investments, decision makers should thus consult expert informants, promote participatory processes and, if possible, invest resources to undertake specialized surveys targeting a set of likely constraints. Chapter 3.5, on combining micro data with farmers' views, presents a methodology to identify the root causes of binding constraints, thereby facilitating the identification of priority areas for policies and investments.

"There is… inadequate data to demonstrate quantitatively the role of animal resources in African economies, and to use such data to create broad awareness among policy-makers and investors."

AU-IBAR Strategic Plan, 2010–2014

HOW TO INVEST?

Once information has been collected on whom to target, the constraints they face, and their root causes, the following process needs to be followed to determine:

Decision makers should draft an implementation plan — including roles and responsibilities of various actors and an estimated budget — which works to identify actions needed to relax or remove the root causes of one or more binding constraints. It is clear that the uniqueness of countries' or localities' investments and limitations on data and indicators preclude the drafting of a fully informed evidence-based implementation plan. Indeed, implementation of policy reforms and investments usually entail or include some form of institutional change — new ways of doing things that have not been yet tried out and for which data is therefore not available.

For example, available information is unlikely to be of use in assessing whether or not the quantity and quality of veterinary services in rural areas is best improved through forming a cadre of community animal health workers (a supply side intervention) or, alternatively, through the provision of

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veterinary vouchers to livestock keepers for the purchase of veterinary services and drugs (a demand side intervention).

This in turn leads to a series of development questions for which little supporting information is usually available. How many animal health workers should be trained? Does a one week training suffice or is a two week course preferable? How frequently should refresher courses be held? Should community animal health workers be given basic equipment (e.g. needles, thermometers and a small stock of medicines, etc.) for free, or at cost?

In order to answer these types of questions, decision makers can review development projects and examine past experience, conduct participatory decision making processes, or set up pilots by which different alternatives are tested on a small scale to identify the most effective, which can then be scaled up. Some reviews include the following:

- Pica-Ciamarra *et al.* (2010) provide a comprehensive review of alternative policy instruments, including pros and cons for their implementation, in different livestock-related domains, such as risk-coping; animal health; feed and forage; access to credit; livestock research; trade; and other. They show, for example, that the quantity and quality of veterinary services could be improved through alternative institutional reforms, such as cost-recovery mechanisms; joint human-animal health service delivery; sub-contracting; provision of smart subsidies to service provides or to livestock farmers; the establishment of community-based animal health workers; and other.
- Murphy *et al.* (2003) compare the efficacy of three school snacks in improving growth and cognitive function of children in rural Kenya. The snacks are composed of equi-caloric portions of *githeri* (a vegetable stew), including *githeri* alone, *githeri* plus milk, and *githeri* plus meat. Total energy intake increases more with the *githeri* plus meat snack than with the other two, because the additional energy provided by the *githeri* alone and by the *githeri* plus milk is counterbalanced by a decrease in the energy content of the food consumed at home. From a policy perspective, the provision of *githeri* meat snacks to rural schoolchildren is shown to be an optimal strategy if the objective is to improve their nutritional status.
- Grace *et al.* (2008) carried out a control trial in South Mali to assess the effects of providing information on the diagnosis and treatment of bovine trypanosomiasis by farmers. Information was given through an eight-page booklet containing pictures with messages on diagnosis and proper treatments. Results show that knowledge of trypanosomosis diagnosis and treatment are 23 and 14 percent greater, after 2 weeks and 5 months respectively, in the treatment group than in the control group. Relatively simple information seems sufficient to reduce the incidence of selected animal diseases.
- Henning *et al.* (2009) conducted controlled trials in 124 randomly selected backyard poultry keepers in nine villages in Myanmar to evaluate two strategies aimed at reducing chicken mortality, namely Newcastle disease (ND) vaccination using a thermostable vaccine and changes in the management of chick rearing (confinement and supplementary feeding). They find that vaccination against ND resulted in a lower incidence rate of mortality during ND outbreaks in households with vaccinated birds, but that crude mortality rate in chicken did not decline and was lower in households with altered chick management. From a policy perspective, investing resources to reduce mortality incidence due to ND makes sense only if all-cause mortality incidence is also reduced.
- Bandiera *et al.* (2012) undertook a randomized evaluation of an entrepreneurship program that provides assets — including cows, goats and poultry birds — and training to run small businesses to the poorest women in rural Bangladesh. They find that, after two years, women participating in the program allocate more time to self-employment (and less to wage-labor), which results in higher income, higher per-capita expenditure, and improved food security for their families.
- Wanyoike and Baker (2013) analyzed 58 livestock development projects to identify factors affecting their effectiveness. Key factors were revealed to be large project size, specialization in livestock issues, inclusion of government in key communication roles, inclusiveness of implementation of exit strategy formulation, and targeting of interventions at several levels of the value chain.

To enhance the probability of good intervention design and implementation, decision makers should assess and rank alternatives, with additional information sourced from expert informants, through participatory and consultative processes; and from past projects and experience, including

those from other countries. As a practical alternative, one more visible to stakeholders, *ex ante* evaluations can be undertaken through pilots on a limited scale that are geared for scaling up.

HOW TO ENSURE EFFECTIVE IMPLEMENTATION?

Once investment choices have been examined and policy options identified, impact is often determined by anticipating data and information needs that ensure effective policy implementation and targeted investments.

Critical to monitoring the effectiveness of development interventions is the existence and/or establishment of a robust monitoring and evaluation system, which regularly assembles quantitative and qualitative indicators of success and project progress. There exist large numbers of reference documents on monitoring and evaluation (e.g. EC, 2006; UNDP, 2009), which target four types of indicators:

- **Input indicators**, which show whether appropriate financial, human and physical resources are allocated to policy and investment implementation. An example is the number and recruitment of public veterinarians.
- **Output indicators,** which measure the immediate effects as determined by access to inputs, e.g. whether more animals are vaccinated against certain diseases as a consequence of increased numbers of veterinarians.
- **Outcome indicators,** which quantify the effects generated by the outputs, e.g. reduced incidence of certain animal diseases.
- **Impact indicators**, which measure the effects of the outcome beyond its direct and immediate results, e.g. increased animal productivity and improved households' livelihood.

In general, input and output indicators should be readily accessible and measurable, as they relate and can be collected within the daily or regular activities of some actors. Outcome and impact indicators are harder to measure and baselines more difficult to derive, which often makes it difficult to properly monitor and assess project/policy impact. In addition, attribution is complicated in many circumstances with outcomes and impacts influenced by a variety of factors, including but not restricted to changes in the known inputs and outputs.

CONCLUSIONS

Decisions on investment and policy formulation in the livestock sector entail a thought process that has been detailed here in terms of sequencing and specificity of information needs. It is clear that decision makers need information on a variety of data domains in order to:

- Demonstrate that livestock sector development can contribute to the broader socio-economic goals of the country.
- Define some typologies of livestock stakeholders, including a clear distinction between market-oriented and subsistence-oriented producers, who have different needs and respond differently to policy and institutional change.
- Identify the major constraints that prevent the various types of livestock producers from making the best use of their animals.
- Identify and rank the root causes of the constraints, which represent the priority areas for investments.
- Design effective policy and investment implementation plans, including specification of roles and responsibilities of the various actors and an estimated budget.
- Monitor and evaluate the implementation of policy reforms and investments.

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BOX 3. A TOOL FOR THE INCLUSION OF LIVESTOCK IN THE CAADP COMPACTS AND INVESTMENT PLANS

The Comprehensive Africa Agriculture Development Programme (CAADP) has been endorsed by African heads of state and governments as a vision for the restoration of agricultural growth, food security and rural development in Africa. CAADP aims to stimulate agriculture-led development that eliminates hunger and reduces poverty and food insecurity by targeting investments in four pillars: land and water management; market access; increasing food supply and reducing hunger; and agricultural research. AU-IBAR is mandated to assist AU member countries to implement the livestock component of the CAADP. To this aim, it has developed a Tool for the Inclusion of Livestock in the CAADP Compacts (AU-IBAR, 2013), which is largely consistent with the stepwise approach presented in this chapter. The Tool identifies a number of core livestock indicators that country governments should collect/generate to adequately represent livestock in the CAADP Documents. The Tool consists of five interrelated modules.

Module I, Mapping and Consulting Stakeholders, assists the CAADP Country Teams (CCTs) in identifying and consulting stakeholders who appreciate the many channels through which livestock contribute to economic growth and livelihoods, including the monetary and non-monetary value of farm animals.

Module II, Livestock in the National Economy, suggests that the CCTs collect/generate a key set of core livestock indicators at national level, which help appreciate whether there are opportunities for livestock sector development to contribute to economic growth, food security and poverty reduction.

Module III, Livestock in the Household Economy, recommends that the CCTs collect/generate core livestock indicators at household level, to help understand the role of livestock in the household economy, including constraints to productivity. Ultimately, this module aims at identifying priority areas for livestock sector investments.

Module IV, Livestock in the CAADP Compacts, clusters Module I and Module II national and household level indicators around the four CAADP pillars, namely land and water management; market access; food supply; and agricultural research. This module assists the CCTs in ensuring that livestock investments are consistent with the CAADP framework and priorities.

Module V, Post-Compact Livestock Investments, gives some basic indications on the data/indicators needed to formulate, implement and monitor & evaluate the livestock component of the CAADP National Agriculture Investment Plan. It also delves into the importance of experimenting or testing alternative implementation mechanisms on a small scale before scaling out investments to the entire country. ■

In particular, knowing with statistical precision the number of animals and the number of livestock farmers at some low administrative level, such as the district or county level, is essential information for effectively designing any intervention on the ground. At the same time, it should be recognized that the data and indicators needed to properly design policy and investment implementation plans are largely unavailable or inadequate due to the novelty and uniqueness of the intervention. Targeted *ad hoc* surveys may help reduce this information gap at one or more stages of the question-driven process described here.

Complete information with all the desired data sets is obviously not achievable, nor economically optimal, and the risk of designing bad policies and investments can never be reduced to zero. However, a statistical system that generates the core livestock indicators as identified in chapter 1.2 and some other data and indicators, complemented by inclusive participatory policy processes, consultations with experts, synthesis of existing experience and analysis, and rigorous *ex ante* pilots, can assist decision makers in designing and implementing policies and investments that are to a large extent effective in promoting a sustainable livestock sector. The next chapter presents a critical review of the prevailing agricultural/livestock data collection system to appreciate what indicators/statistics they are able to produce on a regular basis.

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1.4 DATA COLLECTION SYSTEMS AND LIVESTOCK INDICATORS: GAPS AND PRIORITY ISSUES

KEY MESSAGES

Numerous methods exist for collecting livestock data which range from regular sample surveys and complete enumeration censuses to administrative records and one-off, or *ad hoc* surveys.

Because the spatial distribution of animals is only partially correlated with the distribution of rural households or farms, sampling issues should be given particular attention when designing surveys that aim at generating official livestock statistics.

While a variety of methods exist for collecting livestock data, no single survey satisfies the information needs for policy and investment requirements. Data integration and *ad hoc* collection of data are recommended to generate adequate information on livestock.

MULTIPLE SOURCES OF LIVESTOCK DATA

Core livestock indicators and other indicators needed for livestock sector policies and investments could be generated by multiple data collection systems, including regular and one-off, or *ad hoc,* surveys. Each country, depending on its priorities and resources, could implement — with some regularity — a variety of agricultural surveys, which also target livestock, as well as other non-agricultural surveys which may collect livestock-related information.

This chapter reviews the prevailing and most common systems of agricultural and non-agricultural data collection implemented across Africa, with the ultimate objective to assess if the collected data suffice to generate the core livestock indicators (as identified in chapter 1.3), namely livestock value added; livestock population; livestock production; average market prices for live animals and livestock products; outbreaks of animal diseases, number of animals affected, and number of animals at risk. It also identifies other relevant livestock indicators that major surveys help generate. Below are the major systems of data collection that are discussed in the following sections:

- The agricultural/livestock census;
- Agricultural and livestock sample surveys;
- Household budget surveys;
- Living standards measurement studies;
- Administrative records or routine data;
- Others, such as the population and housing census and labor surveys.

The chapter concludes with a summary table that highlights the main core and other livestock indicators available from major agricultural and non-agricultural surveys, and identifies gaps in the demand and supply of livestock data, both from a quantity and quality perspective, as per the findings of a global survey undertaken by the *Livestock in Africa: Improving Data for Better Policies* Project.

THE AGRICULTURAL CENSUS AND THE LIVESTOCK CENSUS

The largest agricultural statistical operation in any country is the agricultural census. Country governments — namely the Statistical Authority in collaboration with relevant Ministries — usually undertake the agricultural census every ten years, with the objectives to:

- Generate information which reveals the structure of the agriculture sector, especially for small administrative units;

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"Complete enumeration is, however, costly and difficult to implement. Consequently, many countries have been undertaking sample agricultural censuses or large-scale surveys, which collect information from a sample of agricultural holdings."

- Generate data to use as benchmarks for other agricultural statistics;
- Provide frames for agricultural sample surveys.

The agricultural census collects, processes and disseminates data on a limited range of structural items of agriculture, which change relatively slowly over time. These typically include size of agricultural holdings, land tenure, land use, crop areas, irrigation, livestock numbers, labor, ownership of machinery, and use of some agricultural inputs.

Data are collected from agricultural production units, or agricultural holdings. In developing countries, most agricultural holdings are associated with a (small) farm household and relatively few commercial farms, i.e. data are largely collected from smallholders. Face-to-face interviews with the agricultural holder or the enterprise manager by trained enumerators is the most common technique of data collection, though telephone and internet-based interviews have been also utilized. Data are collected in a short time-span, occasionally in just one week.

Data are collected on a complete enumeration basis — i.e. information is obtained from all production units in the country — which allows for the compilation of statistics even at the lowest administrative units, such as the village. Complete enumeration is, however, costly and difficult to implement. Consequently, many countries have been undertaking sample agricultural censuses or large-scale surveys, which collect information from a sample of agricultural holdings.

For example, the National Sample Census 2007/08 of Tanzania collected data from about 53,000 farming households, or about 17 percent of all farming households (URT, 2010); the 2008 National Livestock Census of Uganda collected information from about 964,000 households, or 15 percent of all households (MAAIF and UBOS, 2009). Samples of such sizes are usually sufficient to retain many of the attributes of a full census, even if statistics at the lowest levels, such as villages, cannot be generated.

The livestock content of the agricultural census always includes information on:

- The number of animals on the holding by species.

Species include cattle and buffaloes; sheep and goats; pigs; chicken, ducks, geese and turkeys and other birds; horses, asses, mules and hinnies; other animals, such rabbits, dogs and cats; and insects such as bees (counted on the basis of hives) and silkworms. The number of animals refers to those animals raised/held by the holding on a specific reference date, which is usually the day of enumeration. Sometimes animals are differentiated by age and sex, e.g. cattle are split into cows, bulls, steers, heifers, male and female calves; occasionally, differentiation is made between indigenous/local and improved/exotic breeds.

Compared to agricultural censuses, livestock censuses collect more detailed information on livestock, the content of which varies by country and the focus is often dictated by the prevailing policies and programs which need to be monitored and evaluated. This may include one or more of the following (MAAIF and UBOS, 2009; République du Mali, 2007; République du Niger, 2007b; URT, 2010):

- Livestock numbers by type of breed;
- Livestock numbers by production systems (e.g. zero grazing, tethering, communal grazing, stall-fed, etc.);
- Economically active population in the livestock sector;
- Livestock pest and parasite control methods and access to animal health services/drugs;
- Types of animal feed used;
- Sources of water for animals;

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- Level of production, i.e. number of animals slaughtered, litres of milk produced and number of eggs. Usually, censuses provide information on the quantity of production, not on the value of production, as price data are not collected;
- Ownership of equipment, such as ox-ploughs, ox-planters and ox-carts;
- Consumption of animal-sourced foods.

Agricultural/livestock censuses provide the 'gold standard' in generating accurate statistics on the livestock population in a country, while also providing critical information on the geographical distribution of animals. They also generate information on the structure of the herd, which is required to estimate and project growth rates of animal populations.

Of course, when sample censuses are conducted, there are sampling errors linked to the estimates of the livestock population. This is more the case when the data are from agricultural sample censuses that collect information from agricultural holdings, which may or may not hold livestock. Sampling errors are less pronounced for data derived from livestock sample censuses, where statistical units are livestock holdings. These are thus expected to provide a more precise estimate of the livestock population than agricultural sample censuses.

AGRICULTURAL AND LIVESTOCK SAMPLE SURVEYS

Agricultural sample surveys, including specialized livestock sample surveys, provide governments with structural data on the sector to supplement census information that is usually available every ten years. These surveys provide additional information needed to better design, implement and monitor sector investments. Data from sample surveys:

- Provide broad indications for development planning and investments in the sector, including public sector interventions;
- Help monitor trends in structure and assess performance of the agricultural / livestock sector.

Agricultural/livestock sample surveys target a relatively small sample of agricultural holdings. For instance, the sample of the Rwanda National Agricultural Survey (NISR, 2010) and that of the Permanent Survey of Agriculture of Burkina Faso (MAHRH, 2009) both consisted of about 10,000 households. Samples are usually large enough to generate statistics that are representative on a national level and for major agro-ecological zones/administrative regions. In few cases, such as the 2011–12 Ethiopia Livestock Sample Survey that covered about 68,000 agricultural households, statistics can be also generated for lower administrative units, such as local districts (CSA, 2012). Sample surveys may cover the entire livestock sector, or target only some specific livestock sub-sectors and/or geographical areas, such as the 2004 National Cattle Survey in South Africa (Scholtz *et al.*, 2008) or the 2005/06 Livestock Survey in the Arid Land Districts of Kenya (ALRMT, 2007). Similar to agricultural censuses, face-to-face interviews by trained enumerators with the agricultural holder is the most common technique of data

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collection. These surveys are usually undertaken by the Statistical Authority, even though the Ministries responsible for animal resources may also carry out livestock sample surveys.

The livestock content of agricultural and livestock sample surveys is significant, and particularly comprehensive in the latter. In addition to an agricultural questionnaire, which collects information on basic household characteristics and detailed information on agriculture/livestock, these surveys often include a community questionnaire that collects information on public services, community infrastructure, market prices, etc. The livestock information available from these surveys usually comprises (ALRMT, 2007; MAHRH, 2009; NISR, 2010; Scholtz *et al.,* 2008; Somda *et al.* 2004):

- Livestock number, by species, breed and age;
- Herd dynamics over the reference period (usually one year). Indicators include animal births and deaths, animals lost, slaughtered, marketed and given/received as gifts, etc. This allows projecting herd growth, a critical piece of information for investment design;
- Livestock production (meat, milk, eggs, etc.), including both quantity and value, i.e. price data are collected in these surveys;
- Animal vaccination, diseases outbreaks and treatment, and access to animal health services.

Supplemental livestock information, dependent on the type and objectives of the survey, can include:

- Feed for animals, e.g. fodder from land and hedges; scattered stalks and market purchased feed, etc.;
- Water sources, e.g. rivers, boreholes, wells, etc.;
- Family and employed labor devoted to livestock by type of activity, e.g. feeding, watering, sales and other;
- Ownership of livestock-related assets, such as ox-carts, ox-ploughs, sheds for animals, etc.;
- Distance to markets (in time or space);
- Market infrastructure (e.g. animal health posts; slaughter slabs; markets);
- Consumption of animal-source foods.

Four features of agricultural/livestock sample surveys are worth noting. First, they attempt to capture information on both inputs and outputs, which allow building some indicators of productivity. Second, these surveys often include information on prices, both for inputs and outputs, which are essential to arrive at some measure of profitability and competitiveness of livestock farming. Additionally, this facilitates an identification of bottlenecks along the value chain. Third, they capture information about seasonality in livestock farming through enumerators visiting households in different seasons, or when respondents are asked to provide information for selected questions by season. For milk production, disease outbreaks, live animals marketing and other dimensions, this seasonal information is important for monitoring the sector. Fourth, these surveys occasionally include a question on the household rationale for keeping farm animals, which is a crucial consideration when seeking to make effective investments. Interventions need to be consistent with the incentives influencing households' objectives for rearing livestock. Objectives could include self-consumption of animal food, income generation, security/insurance, and input into the agricultural sector (manure/animal traction) among others.

Agricultural and livestock sample surveys are often perceived as the best information sources for identifying major constraints to livestock productivity and opportunities for investments at the farm level. However, they rarely cover all dimensions of livestock production, nor do governments in sub-Saharan Africa systematically undertake them. Finally, it is worth noting that there are sampling errors when deriving national/regional/district livestock statistics from agricultural and livestock sample surveys. These are more pronounced in the case of agricultural sample surveys, where the statistical unit is the agricultural holding that may or not keep farm animals.

"Agricultural and livestock sample surveys are often perceived as the best information sources for identifying major constraints to livestock productivity and opportunities for investments at the farm level."

HOUSEHOLD BUDGET SURVEYS

Household Budget Surveys — also called Family Expenditure Surveys, Expenditure and Consumption Surveys, and Income and Expenditure Surveys — collect, process and disseminate information on key components of household's budget and expenditures with the objective to:

- Update the weights in the CPI, a critical piece of information to estimate national macro indicators, such as the level of inflation;
- Measure poverty and well-being;
- Generate estimates on household consumption, which feed into the calculation of the Gross Domestic Product (GDP).

Household budget surveys are conducted on a sample of nationally representative households and for agro-ecological zones/major regions. For example, the sample size of the 2002/2003 Lesotho Household Budget Survey comprised 5,992 households, which was representative of the country and its ten districts (LBS, 2008); the 2001 Household Survey of Senegal included 6,624 households, representative nationally and for the 14 regions of the country (DPS, 2004). Similar to other surveys, data are usually collected through face-to-face interviews, but these surveys are unique in that the data is usually collected over a one year period to capture seasonal variations in expenditure patterns. Some information may be also collected daily, such as food consumption and/or expenditures. The responsible agency for implementation of Household Budget Surveys is the National Statistical Authority.

Two relatively unique data sets typically collected through Household Budget Surveys include:

- Consumption of animal-source foods, an important indicator of nutrition and well-being;
- Livestock income and its contribution to total household income.

Questions on consumption of animal foods are usually based on a seven-day recall period. For example, the 2002/03 Lesotho Household Budget Survey includes questions on weekly expenditures on several livestock products, ranging from fresh, chilled and frozen beef to dried, salted or smoked meat, and from whole milk to cheese and curd (LBS, 2008).

To measure livestock income, a direct question is usually asked about revenues from different activities, including wage employment and self-employment in crops and livestock; in a few cases, some details about sales of livestock and livestock products and expenditures are asked to the respondents, which allows for a better estimate of livestock income. For example, the 2009/10 Uganda National Household Survey includes a question about income from livestock farming over the last 12 months, differentiated by cash and in-kind income (UBOS, 2009); the 2007 Niger Household Budget and Consumption Survey (République du Niger, 2007b) includes detailed questions about ownership of livestock and sale of live animals and livestock products.

Statistics on consumption from Household Budget Surveys are designed to be representative at the national level and for macro-regions/agro-ecological zones. Again, challenging the compilation of results and the reliability of the statistics on livestock variables, except for consumption of animal-sourced foods, is the issue of potential sampling errors, as all households and not just livestock-keeping households are the statistical units for this type of surveys.

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LIVING STANDARDS MEASUREMENT STUDIES

Living standards measurement studies (LSMS) are multi-topic household surveys that aim to:

- Measure poverty and well-being and understand their major determinants;
- Provide evidence for planning, monitoring, and evaluating economic policies and social programs in relation to their impact on household living standards, especially those of the poor.

LSMS surveys are administered to a nationally representative, but relatively small sample of households. This allows the generation of accurate, or nationally representative, statistics for the country as a whole and for large sub-areas (e.g. rural and urban areas; macro-regions). For instance, the sample of the 2005 Ghana Living Standard Survey consisted of 8,700 households (GSS, 2008); that of the 2004 Zambia Living Conditions Monitoring Survey comprised about 20,000 households (CSO, 2005). Data in these surveys are collected by the National Statistical Authority — with increasing use of computer-assisted technologies — through face-to-face interviews, often over a period of 12 months in order to take into account any seasonality.

A unique feature of LSMS surveys is their inclusion of several questionnaires that target a variety of information at the household and community level. They include a household questionnaire, a community questionnaire, a price questionnaire and, in some cases, questionnaires on agriculture, gender, and/or fisheries. The household questionnaire comprises sections on education, health, etc.; the agriculture questionnaire includes modules on crops, extension services, and in some countries a significant number of livestock questions; the community questionnaire targets information on local infrastructure, availability of public services, and distances to major markets, etc.

LSMS surveys include some livestock-related questions, which target:

- Livestock ownership, sometimes with details on herd dynamics (animals born, death, lost, etc.) over the reference period, usually one year;
- Consumption of animal products, including self-consumption and market purchases.

In recent years, with the growing recognition of the role of agriculture for livelihoods, poverty reduction and economic growth, the agricultural section of LSMS surveys has been expanding in its coverage, including its livestock content. Recent LSMS surveys in Niger (République du Niger, 2010), Tanzania (NBS, 2012a) and Uganda (UBOS 2011) include a specific section on livestock that collects not only information on livestock ownership, herd dynamics and consumption of animal-sourced foods, but also on:

- Breeds, differentiated by local/indigenous and improved/exotic;
- Use of inputs, including feed, water, labor;
- Access to livestock-related services, such as veterinary drugs, vaccination, extension;
- Husbandry practices, e.g. housing and breeding practices;
- Production of livestock products, including not only meat, milk and eggs, but also dung and other services provide by livestock, such as transport.

LSMS surveys, and particularly those with a comprehensive livestock module, are the best sources of information for quantifying the contribution of livestock to household livelihoods, including both its monetary and non-monetary value. In addition, this type of data can facilitate analysis, *ex ante* and *ex post*, of the impact on livelihoods of selected livestock sector interventions. However, in most cases livestock is still unappreciated in LSMS surveys and, given that the sample of agricultural questionnaires targets only rural households and that sample sizes are small, national level statistics for livestock cannot be always generated with precision from these surveys.

ADMINISTRATIVE RECORD DATA

Administrative record data, also referred to as routine data, are regularly collected by national governments, in collaboration with districts or lower level administrative units, with the objective of:

- Planning, implementing and monitoring the delivery of public services.

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Within a country, government officers at a specifically designated local administrative level (e.g. sub-county, district) collect agricultural data, including livestock-related data, on a regular basis — such as monthly or quarterly. They report to the district administrative unit, which processes the data, uses it when needed, and then reports to a higher level in the administration. The Agriculture and/or Livestock Ministry obtain access to this livestock data and statistics on a regular, or occasionally irregular, basis. An example of administrative data includes cross-border trade statistics, with Customs Authorities at border points documenting trade flows of imports and exports (quantity and value) of live animals, animal-source foods and other livestock products (e.g. hides and skins), which are then summarized in monthly, quarterly and annual reports.

The statistical unit for administrative record data varies and is a function of what data is being collected by which administrative office. For instance, data on prices of live animals may be collected by extension officers at local markets, or by custom officers at the border; the price may refer to live cattle in general, live cattle by breed (e.g. local/indigenous versus improved/exotic), or be by head or weight (kg/live animal). In principal, whatever the statistical unit, government officers are expected to collect data on a complete enumeration basis, i.e. sampling errors are not anticipated in routine data (LDIP, 2010b, 2010c, 2011c, 2012b).

In general, routine data primarily target:

- Outbreaks of animal diseases and other animal-health related indicators;
- Livestock population;
- Production of livestock products;
- Trade of live animals and livestock products;
- Market prices of major livestock items to be included in the CPI.

The content of administrative data varies by country and reporting period (e.g. monthly, quarterly). In Uganda, for

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instance, livestock/veterinary officers at the sub-county level collect information on a monthly basis at the village level. This information includes the number of animals by production system and species; animal movements; outbreaks of contagious diseases, including the number of animals affected, dead/slaughtered and treated, and control measures; number of animals vaccinated against selected diseases, such as Contagious Bovine Pleuropneumonia (CBPP), Brucellosis and Rift Valley Fever; clinical cases handled by local animal health staff by type, such as diarrhea or mastitis; number of meat inspections (*ante-mortem* and *post-mortem*) and condemnations rate; number of animals slaughtered; sales of livestock animals, and prices (average, minimum, maximum); etc. (MAAIF, no date).

Some of the information and data collected, particularly that related to animal disease outbreaks, respond to international obligations which require African countries to submit monthly, quarterly and annual animal health/disease reports to the World Organization for Animal Health (OiE) — the reference organization to WTO for trade-related animal disease matters — the Africa Union-Interafrican Bureau for Animal Resources (AU-IBAR); and selected Regional Economic Communities (RECs).

The importance of animal numbers data, in particular, the number of animals affected by a disease, is a critical piece of information for emergency interventions related to animal health, e.g. to assess the number of vaccines needed to prevent the spread of some epidemic disease. Data on production of livestock products (quantity rather than value) are collected as a rough measure of the performance of the sector, which helps monitor the impact of government policies and programs. Finally, statistics on trade are a critical piece of information to estimate livestock value added, and hence GDP.

Routine data provide a major source of information for the livestock sector. Because of the regular information flow, they are essential to deliver public services and monitor the animal health status in a country as well as trade movements. However, there is dissatisfaction with the quality of routine data in African countries. Financial and human resources are limited at the local level, as are incentives for data collectors. There is rarely a systematic and common approach to collect routine data at local level, with local governments and extension officers using different methods. Routine data are rarely collected from all the relevant statistical units and no statistical procedures are used to select the sample population, while concepts and definitions used are often unsuitable for statistical purposes. Furthermore, they rarely conform to international standards and may even differ from district to district. There is a need for caution, therefore, when using administrative records to generate official statistics (Okello *et al.*, 2013).

OTHER SOURCES OF LIVESTOCK DATA

There are a number of other sources for livestock-related data, including:

- The Population and Housing Census;
- Service Delivery Surveys;
- Labor Force Surveys;
- Marketing Information Systems;
- Experimental Station Records;
- One-off Livestock Surveys.

The **Population and Housing Census**, which is conducted every ten years by almost all governments, may include one or more screening questions on livestock. Typically, one question will target ownership/non-ownership of farm animals and a second one the number of animals owned by species. This is the case in the 2012 Population and Housing Census of Tanzania (NBS, 2012b). Since the Population and Housing Censuses target all households, the inclusion of livestock screening questions help generate an appropriate sample frame for specialized livestock sample surveys and statistically precise estimates of the livestock population. There are concerns, however, whether households correctly report their livestock assets in the context of such surveys. Another issue is that animals in commercial enterprises are not counted in the census.

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BOX 4. LIVESTOCK QUESTIONS IN THE POPULATION AND HOUSING CENSUS

The Population and Housing Census is the largest statistical operation undertaken by country governments, every ten years on average. The census collates information on the quantity and quality of so-called human capital at the national, regional and small area level, and on housing and a population's access to basic services, such as water, electricity and telephone landlines. Results of the census, which have very limited sampling errors, are used to ensure efficiency and equity in the distribution of public resources, such as for roads, human health facilities and schools. They are also used as benchmarks for statistical compilation and as a sampling frame for sample surveys, upon which many countries rely for the generation of good quality statistics on targeted domains. The Population and Housing Census uses the household as its basic unit. The Census of Agriculture and other agricultural sample surveys use the agricultural holding as their basic unit. In developing countries, the largest share of agricultural holdings are managed by the farm household, i.e. a household in which one or more members are engaged in agricultural production activities. It follows that, if farm households were identified in the Population and Housing Census, linkages with the census and the Agricultural Census and other agricultural surveys could be generated, with a multitude of benefits:

The inclusion of farm households in the Population Census allows for identifying all agricultural holdings in the country and, hence, provides a basis to build a sound sample frame for the agricultural census and for agricultural sample surveys. If some questions on agriculture were asked in the population census, the agricultural census could be reduced in scale, thereby generating savings. This information could also be used to better define the coverage of the agricultural census and of agricultural sample surveys, e.g. by improved targeting (minimum farm size). Undertaking the Population and Housing Census jointly with the Agricultural Census or with agricultural sample surveys, or the latter soon after the former, would enable the analysis of a much wider set of data, with the farm household allowing for direct linkages between the different datasets.

A number of agricultural data items can be included in the Population and Housing Census, including on agricultural holders and their characteristics (e.g. sex and age); farm area; crops grown; ownership of agricultural machinery; types of production system and purpose of production; ownership and use of livestock; land tenure; agricultural labor force; gender; and other. The FAO UNFA Guidelines for Linking Population and Housing Censuses with Agricultural Censuses present examples of Population Census Questionnaires (FAO and UNFPA, 2012). These, in most cases, contain the following two questions on livestock:

- Whether the household rears farm animals and, if yes, which species (e.g. cattle; pigs; poultry; etc.);
- The number of animals reared by species.

Responses to the first question are essential to build an effective and up-to-date frame for a livestock census or a specialized livestock sample survey, which may even target one specific sub-sector of livestock (e.g. small ruminants). Responses to the second question provide an estimation of the livestock population in the country, which is particularly relevant for countries that rarely undertake the Agricultural Census and/or undertake Agricultural Sample Censuses. ■

Service delivery surveys aim at providing an assessment of quantity/quality trends in public service delivery. They are sample surveys that allow the generation of national level statistics, which are also differentiated by rural and urban areas and macro-regions. Some questions in this type of survey can target livestock-related services, such as access to animal health and extension services. Sampling errors, however, may make it difficult for these surveys to properly assess the quality of livestock-related services, which are targeted at a relative small segment of the population.

Labor force surveys facilitate an understanding of the status and trends of local labor markets. These sample surveys ask questions on the status of employment for the economically active population (e.g. full-time or part time; employee or self-employed; unemployed; etc.). They may include some questions on livestock. For instance, the Botswana Labour Force Survey explicitly estimates the economically-active population working in commercial livestock and poultry enterprises (CSO, 2008).

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Enterprise surveys are firm level surveys of a representative sample of commercial private enterprises, which include livestock-related businesses, such as milk processors and commercial ranchers. Unless they specifically target agriculture, and livestock within agriculture, these surveys do not supply enough data to produce official livestock-related statistics, such as the average number of full and part-time employees; level of production; share of production sold internally, or exported for commercial livestock-related companies.

Market information systems (MISs) aim to provide farmers, traders and other actors along the supply chain with short-term information on price levels (to guide marketing decisions) and generate medium/long-term information on market trends (to guide investment decisions). Data are usually collected by so-called market monitors in major markets in the country and disseminated through a variety of means, such as market boards, newspapers, radio, and websites, such as for the Tanzania Livestock Information Network Knowledge System (LINKS). There hardly any examples of market information systems that have been operational for more than a few years (LDIP, 2011d).

Experimental stations are usually mandated by research agencies/institutions to conduct field- level research with objectives to assess performance of certain breeds/vaccines/ drugs/feed/ husbandry practices/etc. in targeted agro-ecological zones. Data from these stations cannot be used to generate statistics, but are highly valuable in providing indications on the data quality from other statistical sources, and for identifying options for technical investments in the livestock sector.

Finally, there are **one-off livestock surveys**, which are undertaken to respond to specific information needs. These can be quantitative and/or qualitative; target the entire livestock sector or only specific sub-sectors; review the entire livestock supply chain from input supply to production to consumption of animal sourced foods, or only focus on some of its segments; be nationally representative or be implemented in selected regions and zones; target actors along the livestock supply chain or expert informants. While not implemented on a regular basis, these surveys provide critical information that complement or validate data from regular surveys, thereby contributing to better investment decisions and increased understanding of their impact on the ground.

DATA COLLECTION COSTS

Cost of surveys depend on a variety of factors, including sample size, length and complexity of questionnaire, distribution of the population across the territory, and method of data collection (e.g. paper versus computer-assisted data collection). In addition, the budget should also consider costs related to survey preparation, such as sample design and training of enumerators, and for data analysis and dissemination. Major costed activities while undertaking a statistical survey are the following:

- Preparation and testing of the questionnaire;
- Printing of questionnaire and/or purchase of computer-assisted interviewing equipment;
- Training of enumerators;
- Sampling;
- Data collection, including travel;
- Data analysis;
- Report writing and dissemination.

The main budget items include:

- Personnel (salaries), including survey designers, enumerators, drivers, translators, etc.;
- Personnel (per diem);
- Transportation;
- Consumable, such as papers, pencils, cartridges, etc.;
- Equipment, such as weighing scales and meters and, in some cases, computers;
- Miscellaneous costs, such as phone calls and photocopies.

While identifying major budget items is straightforward, arriving at some general estimation of the costs of agricultural/ livestock surveys is difficult, because costs differ by country. In general, the largest cost is that for personnel, which can account for up to three-quarters or more of the total cost of the survey. Transport costs are second. Evaluating the benefits of the surveys is even more challenging, as this depends on

the subsequent constructive use of the data which, alas, often remain largely unused.

AGRICULTURAL LIVESTOCK DATA COLLECTION SYSTEM AND LIVESTOCK INDICATORS

Table 2 summarizes the major livestock indicators that the reviewed surveys can, on paper, help generate, starting with the core indicators needed by the Ministry responsible for livestock and the National Statistical Authority. It offers six major comments:

- The prevailing system of agricultural/livestock data collection, if functional, could on paper help generate the core livestock indicators, in addition to other indicators needed for policy and investment purposes;
- There is no single survey which, on its own, satisfies the demand for livestock data, not even that for core livestock indicators. Data integration, therefore, is essential for ensuring the generation of good quality core livestock indicators.
- Administrative records are the only data that are regularly collected and, therefore, they are critical to updating the value of core indicators during in-between surveys. Indeed, censuses are undertaken every five or ten years, and sample surveys are rarely done every year. In addition, once collected, it takes at least one year before the data from these surveys are cleaned, processed and results produced and disseminated.
- For the design of livestock sector policies and investments that aim at increasing livestock productivity while also contributing to poverty reduction and food security, data from both agricultural/livestock sample surveys and living standards measurement studies are needed: the former help appreciate constraints to livestock productivity/profitability and the latter the role of livestock in the household economy, and hence the incentives and disincentives that underpin household's livestock-related decisions. However, as said above, neither agricultural/sample surveys nor living standard measurements studies are regularly undertaken in sub-Saharan African countries and, when they are, the livestock sector is often unappreciated in the survey questionnaires.
- Sampling is a major issue when official livestock statistics are generated from sample surveys, as the spatial distribution of animals is often not well-correlated with the distribution of the sampling units, namely rural households and/or farm holdings. This is particularly true in countries with relatively large tracts of arid/semi-arid areas.
- The *Livestock in Africa: Improving Data for Better Policies* Project undertook four online surveys on livestock data/indicators that also targeted stakeholders' perception of the quantity and quality of livestock data. Data availability is often highlighted as a problem by international and national livestock stakeholders, not only because some indicators are seldom available or not accessible when needed, but also because most surveys target farm level and consumption related issues, with little information on factors along the input and output value chains. The quality of data, usually 'fitness for purpose' amongst most National Statistics Office, includes various dimensions (e.g. relevance, accuracy, timeliness, accessibility and interpretability) and qualitative categories (e.g. excellent, good, adequate, poor and very poor), which are subject to personal interpretation. Again, stakeholders tend to not trust the quality of available livestock data: results of a Global Survey (Pica-Ciamarra *et al*. 2012) on livestock data and indicators indicates that over 41 percent of the 641 respondents rate as poor or very poor the quality of available livestock indicators, with only 21 percent assessing them as good (Figure 2).

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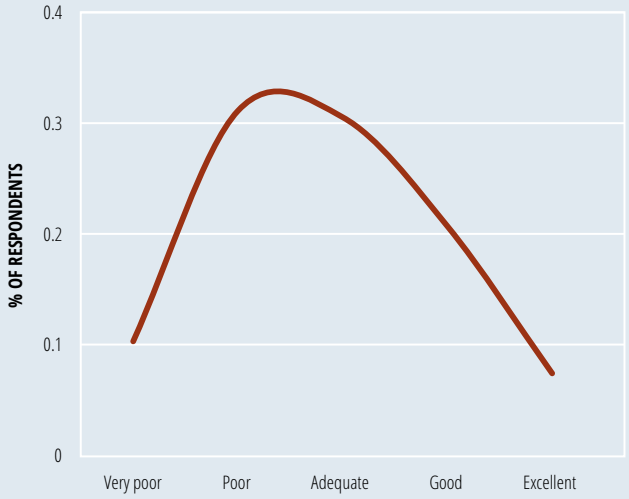
TABLE 2. DATA SOURCES FOR LIVESTOCK INDICATORS

Core indicator \ Survey		Agricultural / Livestock Census	Agricultural / Livestock Sample Surveys	Household Budget Surveys	Living Standards Measur. Studies	Administrative Records
Livestock Population		***	**	No	*	**
Livestock production		*	***	No	*	**
Market prices		*	***	***	**	***
Outbreaks of animal diseases / animals affected / animals at risk		no	no	No	no	***
Livestock value added	Animal stock, beginning and end of reference period	*	**	No	**	***
	Production, quantity	*	***	No	**	**
	Input, prices	no	**	No	*	no
	Production, prices	*	**	No	*	***
	Input, prices	no	**	No	*	no
	Imports / exports	no	no	No	no	**

Core indicator \ Survey	Agricultural / Livestock Census	Agricultural / Livestock Sample Surveys	Household Budget Surveys	Living Standards Measur. Studies	Administrative Records
Productivity-related indicators	*	***	No	*	*
Profitability-related indicators	no	***	No	*	no
Constraint-related indicators	*	***	No	*	no
Livestock-livelihoods indicators	no	*	No	***	no

*** very likely; ** likely; * possible

FIGURE 2. QUALITY OF LIVESTOCK DATA AS PERCEIVED BY STAKEHOLDERS



Source: Pica-Ciamarra *et al.*, 2012

CONCLUSIONS

It is clear that a multitude of surveys regularly collect data on livestock and that, on paper, a functional agricultural/livestock statistical system could support the generation of the core livestock indicators and some other key livestock policy/investment indicators. However, given that there is no single survey that fully responds to the information needs of major livestock stakeholders, the possibility of making effective investments in the sector strongly depends on undertaking specialized surveys when policies and investments are designed and on the possibility of jointly using data from different surveys; in other words, on the possibility of data integration.

Currently stakeholders contend that their demand for information remains often unmet, including both the quantity and quality of available livestock data. This suggests the need for investments to improve the agricultural data collection system targeting livestock and/or addressing livestock-specific data issues. Part II of this Sourcebook presents examples of methodologies that governments can apply/adapt to produce more and better quality livestock data.

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PART II.
METHODS TO IMPROVE THE QUANTITY AND QUALITY OF LIVESTOCK DATA

2.1 COHERENT AND COMPREHENSIVE INFORMATION: DESIGNING A LIVESTOCK QUESTIONNAIRE FOR AGRICULTURAL AND INTEGRATED HOUSEHOLD SURVEYS

KEY MESSAGES

Neither agricultural nor living standards measurement surveys are regularly undertaken in sub-Saharan African countries. When they are implemented, the livestock sector is often under-appreciated in the survey.

A standardized questionnaire including livestock in agricultural and household surveys allows a better appreciation of the role of animals in the farm and household economy, which is a pre-condition for the effective design of sector policies and investments.

Challenges in developing a livestock questionnaire include the different objectives of the National Statistical Authority and the Ministry responsible for livestock, the former willing to keep the questionnaire as simple as possible and targeting few data items, while the latter aims to have it as detailed as possible, targeting broad information on livestock.

INTRODUCTION

Stakeholders contend that available agricultural data collection systems, as chapter 1.4 shows, are to a large extent insufficient to generate adequate livestock-related information, because of both a lack of and insufficient quality data. The most straightforward way to increase the available

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information on livestock is to ensure the adequate inclusion of livestock in the questionnaires of surveys, which are regularly undertaken by national governments, such as the agricultural census, the agricultural sample survey or the living standards measurement study (LSMS).

This chapter presents a set of livestock questions — so-called 'livestock module' — to be considered for inclusion in agricultural/livestock sample surveys and in multi-topic household surveys. The focus is on farm and multi-topic household surveys — and not on surveys targeting commercial enterprises — as in most developing countries the largest share of animals are kept by farm households or livestock keepers. Data from farm and multi-topic surveys, as Table 2 in chapter 1.4 illustrates, can on paper generate almost all the livestock-related indicators needed by stakeholders, though they are to be complemented by data from other sources when policy and investment plans are to be detailed (chapter 1.3).

The next section provides the rationale for developing a livestock module for agricultural/livestock sample surveys and multi-topic household surveys. A section that highlights the salient features of the livestock module follows, including the approach used to develop it. Then lessons from the implementation of the module in multi-topic household surveys in Niger, Tanzania and Uganda are presented, followed by recommendations on how to apply and improve it.

LIVESTOCK IN AGRICULTURE SURVEYS AND IN MULTI-TOPIC SURVEYS: A SNAPSHOT

Livestock keeping is a multi-functional activity in developing countries: farm animals generate food and income, are a store of wealth and act as a safety net in times of crisis. They provide draught power and hauling services, manure, fuel and building material; transform crop residues and food wastes in valuable protein and contribute to social capital (FAO, 2009). Rural households have thus a variety of incentives for keeping livestock and, indeed, data from 12 developing countries in Africa, Asia and Latin America show that between 46 to 85 percent of rural households keep farm animals, with a country average of about 60 percent (FAO, 2009). Many of these households are poor and, given the important role livestock plays in their household economy and that many livestock animals are not meeting their full productivity potential, it is anticipated that increases in livestock productivity can help achieve the overarching goals of poverty reduction and food security, and other broad socio-economic goals.

A review of a handful of both agricultural/sample survey and multi-topic household survey questionnaires, however, reveals that livestock is, in most cases, inadequately represented. For example:

- The 2008 Rwanda National Agricultural Survey includes only a few livestock-related questions: the number of animals by species; type of feed; farming methods, notably stabling or roaming; ownership of a cowshed; and then information on sales of animals and home slaughtering (NISR, 2010);
- The 2010/11 Livestock Sample Survey of Ethiopia, one of the few countries in sub-Saharan Africa that regularly undertakes agricultural sample surveys, includes questions on animal population by breed, age and purpose for keeping; on births, purchases, death and slaughters of animals; on livestock diseases, vaccination and treatment over the reference period; on utilization of livestock feed; and on participation in a livestock extension program (CSA, 2010);
- The 2008 Livestock Survey in the Arid Land Districts of Kenya collected information on livestock numbers by species and, within species, by breed, age and sex; on changes in stock due to births, deaths, purchases, sales, social reasons (gifts), slaughter and theft; on production and sale of milk, ghee, honey and hides and skins (ALRMT, 2007);
- The 2005 Ghana Living Standard Measurement Survey includes questions on livestock ownership by species, as well as sales and purchases of live animals over the last months; questions on expenditure for raising livestock, including feed, veterinary services and drugs, hired labor and some other; revenue from selling milk and eggs; and self-consumption of animal products (GSS, 2008);
- The Malawi Integrated Household Survey 2010/11, which does have a specific focus on agriculture, includes questions on livestock ownership by species; change in stock over the past 12 months (purchases, sales, slaughter, given away as gift, etc); disease and vaccination; and total expenditure on hired labor; feed, vaccines; veterinary services and other; production of milk, meat, eggs, manure and honey (NSO, 2010);

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- The 2010/11 Nigeria General Household Survey contains questions on animal holdings, including change in stock in the past 12 months due to births, sales, slaughter and other reasons; on major diseases affecting animals and vaccination; and a final question on the expenses incurred for tending the entire herd, such as on hired labor; animal feed; maintenance of pens and stables; and commission on sale of animals and a few others (NBS, 2010).

In general:

- Available data in agricultural/livestock sample surveys and in integrated household surveys are sufficient to generate descriptive statistics on livestock ownership; sometimes on production and, occasionally, on inputs with a focus on access to animal health services. Data from integrated household surveys do also allow classifying/grouping households according to some livelihoods criterion (e.g. income level).

- However, data are rarely sufficient to provide a systematic picture of the livestock sector of the country because of limited/missing information on husbandry practices, inputs and outputs, such as breeding practices; feed and water access; production and use of manure; the use of animals for hauling services and draught power; and other. The implication is that the overall understanding of the livestock sector is patchy at best.

- Data from both surveys do not provide a good understanding of the determinants of livestock productivity, which involves some ratio between outputs and inputs. Even when information is asked about inputs, this targets mainly value (and not quantity), and in most cases is asked regarding the herd as a whole, i.e. it is not possible to attach inputs to the different animal species or to individual animals.

- Data from integrated household surveys provides some ability to measure the contribution of livestock to household livelihoods and to investigate the basic determinants of livestock ownership, such as family size, land ownership, level of education, level of income; etc. However, this data neither captures the non-monetary livestock services provided by livestock, such as manure, draft power and insurance, nor allows exploring the livestock-gender and livestock-youth relations.

Overall, insights into the rationale for investing in livestock to reduce poverty, including identification of major production-related constraints, are in many cases challenged by a lack of adequate information on the role and use of livestock in the household/farm economy.

A LIVESTOCK MODULE FOR AGRICULTURAL AND MULTI-TOPIC HOUSEHOLD SURVEYS

With the objective to assist decision makers in collecting more comprehensive livestock-related information at household level, the FAO, the World Bank, the ILRI and AU-IBAR, in collaboration with national governments in Niger, Uganda and Tanzania, developed a short, a standard and an expanded version of a livestock module for multi-topic household surveys and agricultural surveys.

The module was developed as follows. First, a variety of multi-topic household survey questionnaires and

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agricultural/livestock survey questionnaires implemented in developing and transition countries were collected. Survey questionnaires are often included as appendices of statistical reports; are sometimes available on the website of the national statistical office; and some are made publicly available by the International Household Survey Network.

Second, a production function approach was used to identify the information set needed to provide a satisfactory picture of the livestock sector. This involved systematizing all inputs and outputs associated with animal keeping, such as feed, water, animal housing, animal health, animal slaughtering, milk production and marketing.

Third, working groups were formed around each component of the production function and tasked to identify a set of questions to possibly include in agricultural and integrated household surveys, using the collated questionnaires as a starting point. No upper limit was set to the number of questions to propose, but the scope, content and typical length of agricultural/livestock and integrated household survey questionnaires were illustrated to group members.

Finally, the questions proposed by the working groups for the various segments of the production function were assembled and made consistent to generate an expanded module for agricultural/livestock surveys and multi-topic household surveys. This expanded module consists of over 200 livestock-related questions, which makes its inclusion in typical agricultural and household surveys impossible. A standard and a short version of the module were therefore developed, which national governments may easily adapt and include in their survey questionnaires. The three versions of the module 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;
- Measure the value of household's livestock, which are an important economic asset;
- Measure the cash and in-kind income from livestock;
- Model household's livestock husbandry and production practices.

The module solicits information in three major domains: livestock ownership; livestock inputs, i.e. husbandry practices; and livestock outputs. Processing is omitted (but for one question) as it is a non-farm enterprise activity that is typically addressed in other types of surveys.

TABLE 3. CONTENT OF THE LIVESTOCK MODULE FOR AGRICULTURAL AND MULTI-TOPIC 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.

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Short version

The short version of the module includes questions on livestock ownership by species (e.g. cattle) and type of animals within species (e.g. bulls, steers, cows, etc.), and a question on the major purposes for keeping animals. It inquires about sales of animals by species over the reference period, which is 12 months for large and medium animals (e.g. cattle, sheep and goats) and three months for small animals, namely short cycle animals (e.g. chicken, ducks and rabbits). It includes some questions on meat, milk and egg production, and one only question on husbandry practices. The latter targets animal vaccination which, in most countries, is provided for free or subsidized by the public sector.

The short version of the module allows quantifying with some accuracy a household's livestock wealth, and hence classifying households into different types; it also provides a rough measure of the cash income derived from livestock. It does not provide a comprehensive picture of husbandry and production practices. This version comprises about 30 questions and is intended for use in surveys for which livestock is a minor interest.

Standard version

The standard version of the module collects a large amount of livestock-related information, including ownership of animals, inputs and husbandry practices, and livestock outputs by product, by-product and service, such as milk, manure and draft power. As in the short version, questions on livestock ownership target species and types of animals; while all other questions only inquire about animal species, such as large ruminants, small ruminants and equines.

Questions on change in animal stock over the reference period collect information on the causes of herd reduction/expansion, including purchases, sales, slaughters, gifts and loss of animals for different reasons (e.g. death due to disease; theft; etc.). Questions on inputs and husbandry practices target housing and breeding practices; access to and use of water and forage/feed; and animal health, including vaccination, deworming and treatment of sick animals.

Finally, questions on outputs inquire not only about meat, milk and egg production, but also about the use of animal power (draft and transport services) and the production of dung, mainly but not only, used as manure. Most sub-sections include questions on the use of family labor by gender, and on the non-family labor hired for raising animals.

The standard version of the module supports generating descriptive statistics for key livestock-related variables, for which nationally representative indicators are often unavailable. Examples include ownership of exotic breeds; prevailing breeding practices; and access to veterinary services. It also allows quantifying with accuracy not only a household's livestock wealth, but also the contribution of livestock to household livelihoods, including both their monetary and non-monetary value. In addition, depending on the sample size and the species at hand, it can be used to estimate production functions using the animals as unit of observation, particularly when it is included in specialized livestock surveys. The standard version of the module comprises about 95 questions.

Expanded version

The expanded version of the livestock module includes all the questions in the standard version, plus additional information in all sub-sections. In particular, it allows differentiating between animal ownership and animal keeping, as not all households owning livestock raise them on the farm; it includes questions on the providers of goods and services, such as the public and private sector, and NGOs; it asks details about the role of family members in selling animals and livestock products, including who controls the earnings.

The expanded version of the module allows generating key livestock statistics and undertaking analyses as with data from the standard version, but with higher accuracy. It's a long and heavy version and, as such, it should be seen as a rotational module that country governments implement only when they need comprehensive and detailed information on livestock, most likely for a specific sub-sample of the population (e.g. the cattle keepers). In response to specific information needs, however, survey designers may wish to include only one or selected sub-sections of the expanded version of the module in their survey questionnaires, such as those on breeding and animal health.

"The expanded version of the livestock module includes all the questions in the standard version, plus additional information in all sub-sections."

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IMPLEMENTING THE LIVESTOCK MODULE: LESSONS

The three versions of the livestock module for agricultural and multi-topic household surveys are starting points for developing questionnaires that fit the needs of the country. Survey designers are expected to build their own module that adapts to the country livestock sector, including its structural and transitory features.

Three sub-Saharan African countries so far have used the livestock module to improve the livestock content of their multi-topic survey questionnaires, including Niger (Enquête Nationale sur Les Conditions de Vie des Ménages 2011/12), Tanzania (National Panel Survey 2011/12) and Uganda (National Panel Survey 2011/12). Some lessons drawn out of questionnaire design and administration and from a descriptive analysis of the Niger data are as follows:

- While the Ministry responsible for livestock prefers to include as many questions as possible in survey questionnaires, the Statistical Authority prefers keeping the livestock module as short as possible, for at least three reasons. The first is savings: not only does a longer livestock module involve more costs, but it could also give non-livestock stakeholders arguments for expanding other sections of the questionnaire, such as those on health or education. The second is a statistical reason: agricultural/livestock and integrated household survey questionnaires are administered to a relatively small sample of households, and detailed questions are sometimes answered by just a few households, which make the collected data insufficient for any robust statistical analysis. For example, a question on the sale of dung cakes would make little sense in the context of multi-topic household surveys. Third, Statistical Authorities analyze — because of their specific mandate — only part of the collated data: for example, they have little interest in studying the

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preferred outlet markets used by farmers or in exploring the correlation between household size and structure and herd size and composition. In addition, they are well aware that there are few other actors in the country capable of analyzing the data. Indeed, there are several surveys for which most of the data remain unutilized, a net waste of public resources.

- The Ministry responsible for livestock has three arguments for advocating the adequate inclusion of livestock in multi-topic household surveys. The first is based on data showing that, as is the case in most developing countries, the majority of rural households keep some farm animals and that livestock contribute over one third to the value added of agriculture. The implications are that it is important to ask questions on livestock, as these are likely to be answered by the majority of households; and that a crop-focused questionnaire would be largely unable to properly appreciate the livelihoods of rural households. The second argument is that, even though some questions might be of little statistical relevance, these are potentially important for decision makers because they provide critical policy information, such as data on the proportion of households with exotic breeds of animals. Finally, the Ministry responsible for livestock must show a commitment to collaborating with the Statistical Authority to examine the livestock content of the surveys. It should be noted that, in almost all developing countries, staff in the Ministry responsible for livestock are not equipped to analyze the data collected through household surveys; however, they are the most important users of the data.

- While implementing the livestock module, survey designers should adjust the suggested list of animals in the module, which is comprehensive, to be consistent with the prevailing livestock production systems. This could be done at three levels. First, some animals are simply not present in a given country, such as yaks in Uganda, and should not be included in the survey questionnaire. Second, while the module allows separating local/indigenous from improved/exotic breeds, in many countries the diffusion of the latter is so minimal that it may make sense to only differentiate animals by breed in the section on animal ownership. In the same vein, there are animals that are not widely held by households, such as pigs in Niger. Again, in these circumstances, it makes more sense to collect minimal information on ownership of pigs in order to generate some basic statistics, but not to ask details about inputs and outputs, as the sub-sample of pig producers is not large enough to generate data for robust descriptive statistics or causal analysis.

- Animal health/disease information is critical for country governments, particularly that pertaining to trans-boundary and zoonotic diseases. Following a standard approach, the module suggests asking direct questions about animal diseases, such as brucellosis, ovine rinderpest (*Peste des petits ruminants*) and Newcastle disease in poultry. However, not all farmers are fully aware of the types of diseases that affect their animals. Complementary information, such as from veterinary officers, could thus be gathered while analyzing the animal health section of the module. Alternative options to collect animal health information also could be designed and tested. One possibility is to use a syndromic approach, which implies asking syndrome-related questions on the basis of clinical features (e.g. neurological, respiratory, dermatological and diarrheal syndromes); the collated data should be interpreted jointly with local animal health authorities. A second possibility is to include animal disease questions in both the household and community questionnaire of the multi-topic surveys, along the lines of participatory epidemiology.

- Measuring labor has been found to be particularly challenging for two reasons. First, in many circumstances, with the possible exception of milking, the labor force performs the same task (e.g. taking animals to graze) simultaneously for all animals in the herd, and in particular for large and small ruminants (e.g. cattle and sheep). Second, watering and feeding animals are often joint activities, with livestock taken to pastures where water sources are available. The implication is that attaching labor to a specific task or an individual animal is difficult, thereby making it challenging to measure labor productivity. The module presents one way to address this issue: by first asking whether animals of different species are fed and watered jointly; and then asking questions on the time allocated to feed/water animals by family and non-family labor. Other options could be designed and tested.

- When collecting information on livestock production, the module proposes an approach which differs from the one typically used in multi-topic household and agricultural surveys. In particular, rather than directly asking

information on meat, milk and egg production, the module asks a sequence of questions that link animals with production levels. This helps the interviewee to provide accurate information on production levels and to arrive at some measure of partial productivity (e.g. eggs per hen over the reference period). For milk, for instance, questions are included about the number of milked animals over a reference period; the number of months during which the animals were milked; whether suckling was allowed when the animals were milked; and the average quantity of milk produced per day during the milking period. Similar series of questions are suggested to obtain meat and egg production information.

The above are the major lessons emerging from the administration of the livestock module in the multi-topic household surveys of Niger, Uganda and Tanzania. Additional insights on strengths and weaknesses of the module will become clear as the country data for Uganda and Tanzania is analyzed. The analysis will highlight possible weaknesses in the module and priority areas for improvement. In any case, the Niger, Uganda and Tanzania surveys represent the most comprehensive household-level livestock datasets available in sub-Saharan Africa, thus facilitating the analysis and documentation of the many connections between livestock and livelihoods. The forthcoming insights from these surveys are expected to significantly enhance our understanding of the role of livestock in the household economy.

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CONCLUSIONS

Traditional agricultural/livestock sample surveys and multi-topic household surveys inadequately represent livestock, despite the fact that livestock are a widely owned asset among rural households in developing countries, including the less well-off. This challenges the design and implementation of equitable and efficient interventions in the sector.

This chapter presented a short, a standard and an expanded version of a livestock module for agricultural surveys and for multi-topic household surveys. The three versions of the module, with different level of details, aim at collecting data to generate statistics on key livestock-related variables; measuring the value of a household's livestock; measuring cash and in-kind income from livestock; and understanding and modeling the household's livestock husbandry and production practices.

The three versions of the livestock module are starting points for developing country modules that fit the needs of the country at hand. Three sub-Saharan African countries have so far used the module to improve the livestock content of their multi-topic survey questionnaires, including Niger, for the *Enquête Nationale sur Les Conditions de Vie des Ménages* 2011/12, Uganda, for the National Panel Survey 2011/12, and Tanzania, for the National Panel Survey 2010/11.

Lessons drawn from the design and administration of the survey questionnaires indicate that, unless the Ministry responsible of livestock is aware of the content and scope of the survey questionnaire and commits itself to analyzing the produced data, the Statistical Authority will prefer avoiding expanding the livestock section of any survey. As to the implementation of the module, at least in the context of multi-topic household surveys, the major challenges relate to measuring labor and animal health/diseases. These represent areas for further research.

The short, standard and expanded versions of the livestock module for multi-topic household surveys and the survey questionnaires for Niger, Tanzania and Uganda are available to download from the websites of the FAO-WB-ILRI-AU-IBAR *Livestock in Africa: Improving Data for Better Policies* Project and the World Bank LSMS-ISA Project. The data from the livestock module implemented in Niger, Tanzania and Uganda are also freely available for download and use.

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2.2 IMPROVING LIVESTOCK DATA QUALITY: EXPERIMENTS FOR BETTER SURVEY QUESTIONNAIRES

KEY MESSAGES

Asking questions that generate accurate livestock data — on animal diseases, labor inputs and milk production — is sometimes challenging, as farmers might have imprecise information on those and other variables.

Randomized experiments, by which different questions targeting the same information are asked to farmers, are an effective method for identifying the best way to formulate specific questions and improve survey questionnaires content.

Transparent dialogue and collaboration with livestock stakeholders is necessary to effectively formulate livestock survey questionnaires, particularly those targeting sub-segments of the population, such as pastoralists.

"When designing survey questionnaires, decision makers should take into account both livestock-specific and system-specific characteristics."

INTRODUCTION

The design of a livestock survey is not necessarily straightforward, due to the complexity in the production and marketing processes, in the management of livestock assets, and in the lifestyle of some population groups that are especially reliant on livestock for their livelihoods (e.g. nomadic, semi-nomadic, or transhumant livestock keepers). All of these factors pose particular challenges to data collection.

When designing survey questionnaires, therefore, decision makers should take into account both livestock-specific and system-specific characteristics. However, in most cases, practitioners who are tasked designing a new survey often have little to rely on other than their own technical expertise, experience and common sense. Moreover, the lack of a systematic approach to survey design often results in less than optional survey questionnaires, and hence in the generation of inaccurate data.

This chapter proposes that there is much to be gained by developing, adopting and disseminating good practices for survey construction which facilitates the systematic assessment of the choices made in questionnaire design and feeds into an understanding of how those choices influence the quality of the data collected. Drawing on survey experiments in Niger and Tanzania focused on milk production and pastoralist livelihoods respectively, this chapter sketches possible practical approaches to conducting various types of survey validation exercises.

PRE-TESTING: DO AS WE SAY, NOT AS WE DO

In their guidelines on methods for testing and evaluating survey questions, Presser *et al.* (2004a, p. 109) note that *"pretesting's universally acknowledged importance has been honoured more in the breach than in the practice."* Even in countries with well-managed and financed statistical systems, pretesting is often limited to a dry run of survey interviews, usually targeting a fairly limited number of households, which are then qualitatively evaluated by the survey teams so as to draw

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lessons from questions that seem to pose problems to interviewers or respondents. Sometimes this is complemented by a quantitative analysis of response frequencies and other simple statistics from the data collected during a pilot.

Often there is little that is systematic about these tests, despite the use of techniques which assess the performance of survey instruments (see e.g. those reviewed in Presser *et al.*, 2004b, and Iarossi, 2006). This is aggravated by a lack of documentation on the process and results of such tests. The evaluation of what 'works' is mostly left to the judgment and experience of the survey team.

Increasingly, however, survey practitioners are paying attention to pre-tests as a means of improving data quality. Also, specific methods are being developed, tested and codified and increasingly applied in survey practice. The interested reader is referred to Presser *et al*. (2004b) for a review of methods such as cognitive interviews, behavior coding, response latency, vignette analysis, experiments, and statistical modeling.

While the use of such methods, and their documentation, is more commonly found in OECD country surveys, their application is being adopted in low-income countries, including in Africa. A literature is slowly emerging, which includes tests of consumption expenditure data (Joliffe, 2001; Beegle *et al.*, 2012), recall methods in agricultural surveys (Beegle *et al.*, 2011), agricultural production diaries (Deininger *et al.*, 2012), child labor (Dillon *et al.*, 2012), labor statistics (Bardasi *et al.*, 2010), and micro-enterprise profits (de Mel *et al.*, 2009).

Within the livestock sector, numerous areas have been highlighted as particularly challenging for survey design. In consultations with livestock and household survey experts, the two specific topics which were cited as particularly problematic were the collection of data which feed into calculations of milk production, and the collection of data on mobile (pastoral) households/herders.

This chapter reviews experiments in livestock questionnaire elaboration within the context of household surveys in specific African countries, namely Tanzania and Niger. The process of conceptualization, design, implementation and analysis of these exercises is described for survey practitioners interested in potentially employing similar approaches to the pre-tests of new livestock-related questionnaires. The methods employed in these two examples represent distinct ends of the spectrum of possible approaches. The one targeting improved survey data on milk production in Niger is a randomized 'experiment' in which randomly selected sub-samples were asked alternative sets of questions aimed at capturing household milk production. The other is a more qualitative, but systematic and documented, pilot test of a questionnaire on pastoral households in Northern Tanzania.

It is important to note that the decision on the empirical approach to take is a function of the type of research objectives and the underlining questions being asked in each exercise. For reasons that will become clearer in the discussion that follows, randomized experiments can be useful to compare 'discrete' approaches, less so to fine tune a draft questionnaire where there are several interrelated and maybe far-reaching design questions that need to be pinned down.

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RANDOMIZED EXPERIMENTS: MILK PRODUCTION IN NIGER

Nationally representative household surveys typically lump the data collected on livestock products into one table listing the different products on the rows and a set of standard questions, common to all products and based on a 12-month recall period, in the columns. The module usually asks a variation on two rather simple questions: (1) "Number of production months in the last 12 months", and (2) "Average production per month during production months." Sometimes these questions are asked for milk as a homogeneous product, sometimes the product is broken down in different types of milk (cow, sheep, goat).

Because of the peculiarities of milk production[1], it is a well-known fact among livestock experts and statistical practitioners that collecting reliable milk production data with such simple recall questions is likely subject to errors. This has led livestock researchers and livestock survey specialists to devise more complex strategies to generate more accurate milk production data and additional information useful to evaluate milk production systems.

Examples of these alternative approaches include the *12_mo* method developed by researchers in CIRAD (see Lesnoff *et al*., 2010) which relies on the monitoring/recording of production over extended periods of time. To increase the accuracy of the responses, techniques are introduced that, while based on recall approaches, prompt more in-depth information from the respondent about the milk production system. In developing new survey approaches to integrate into household surveys that include an expanded agricultural focus, these methods are useful, but need to be adapted to conform to both the objective of the survey and to the survey operations. The only way to assess whether a change in approach results in an actual improvement in data quality is to validate the new method via fieldwork, ideally in an experimental setting, while reproducing as closely as possible real survey conditions.

1 There are a host of features of milk production for human consumption that make recall particularly hard: Milk is produced continuously, but with seasonal patterns. The lactating capacity of animals varies over time, across animals, and is dependent on the management of the animals. The farmer may additionally decide not to collect milk independently of the production capacity of the animals, and often part of the milk is used for suckling offspring.

It is beyond the scope of nationally representative household surveys, in terms of both objective and logistics, to collect milk production data over extensive time periods, or in a way that allows calculating the complex milk productivity parameters often required by livestock sector specialists. The objective of a nationally representative household survey is more modest, and limited to collecting a reliable measure of milk production that can accurately portray the role that milk production has in the overall household livelihood strategy.

At the same time, surveys aim to look at the heterogeneity across households. This implies that methods that rely on the application of technical production factors from the literature (e.g. average milk production per animal in a certain environment) combined with variables that may be easier to measure in a survey (such as the number of animals milked by the household) may result in accurate 'average' estimates, but may artificially reduce the observed differences in milk production (both in physical and value terms) across households. For most of the analyses performed with household level data, the analysis of the dispersion of the distribution is often as important, if not more so, than the analysis of the measures of central tendency (means, medians). For these reasons, alternative data collection methods need to be evaluated, not only on the basis of their ability to yield an accurate point estimate of, say, mean milk production, but also on their ability to return a distribution of observations that resembles as much as possible the 'true' distribution.

In view of these considerations, an experiment was implemented in Niger which reviewed and compared two methods that are often applied in livestock sector surveys. These two methods, supported by different questionnaires, are referred to as the "Average milk per day" (AMD) and the "Lactation curve" (LC) methods. Both seem to hold the promise of being adaptable to both the questionnaire design and logistics of a nationally representative multi-topic household survey.

The two questionnaires are amenable to testing in an experimental setting because they represent a discrete change in survey design. In a broad sense, they are virtually identical, except for questions related to milk production. Both questionnaires start off by prompting the respondents about the number of months during which animals were milked for human consumption, and how many animals, by animal type (bovines, sheep, goats, camels), were milked on average during each of those months.

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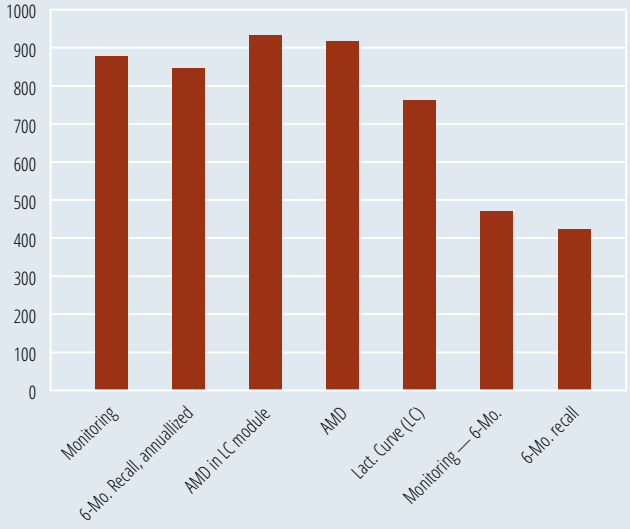
The questionnaires themselves differed in that the AMD asked for the average quantity per day produced by each milked animal during the period, whereas the LC questionnaire asked about the amount of milk produced by each animal at three (four) different points in time: one week, one month, and three (and six) months after parturition, e.g. after reproducing. The two modules then continue asking the same set of questions on issues of whether calves/lambs/kids were allowed to suckle, about the time gap between parturitions, and about the disposition of milk production (sales, consumption, and transformation into dairy products). Annual milk production can be calculated from both questionnaires. In the AMD, this involves simply multiplying the average daily production by 30 days (to get to monthly production per animal), then by the number of months of milk production. Using the LC method, the calculation is more complicated with annual production derived as the area under each animal's lactation curve, or the milk production curve.

One challenge in assessing data quality is that of identifying a benchmark, or a 'gold standard' against which the survey measures can be compared to assess their accuracy. In the experiment in Niger, such a gold standard was constructed by performing a physical monitoring of actual milk production every other week for 12 months, using a sample of around 300 households. The same households were then interviewed using the two recall methods. The comparison yielded interesting insights into the relative performance of the candidate recall methods. Statistical analyses were later used to analyze not only the relative performance of the alternative recall methods, but also, and perhaps more importantly, to review how measurement error (or the deviation from the benchmark) varied by household and respondent characteristics, as well as with specific variables of interest (e.g. does measurement error increase or decrease with larger herd size, or with respondent's education?).

In the case of the Niger milk production example, a comparison was drawn between four competing recall methods: the AMD and LC methods over 12 months; the AMD, but based on a combination with the LC questions; and the AMD, but based on a shorter recall[2]. The results allowed for ranking of the methods, based on their variance from the results of the monitoring. The AMD recall performed better, in all its variants, than the LC method, which appeared to underestimate production while also displaying a low correlation coefficient with the monitoring variable (r=0.38). Shortening the recall period to six months appeared to result in the most accurate estimate (about 3 percent difference in mean value compared to 5 to 6 percent with the 12 month recall). The six-month recall also showed the highest correlation to the benchmark at 0.71. When using a 12 month reference period for the AMD method, it appears that also including questions on the level of production at different points in the lactation can aid recall, resulting in a marginal difference in mean values, but in a substantial improvement in the correlation coefficient (from 0.44 to 0.61).

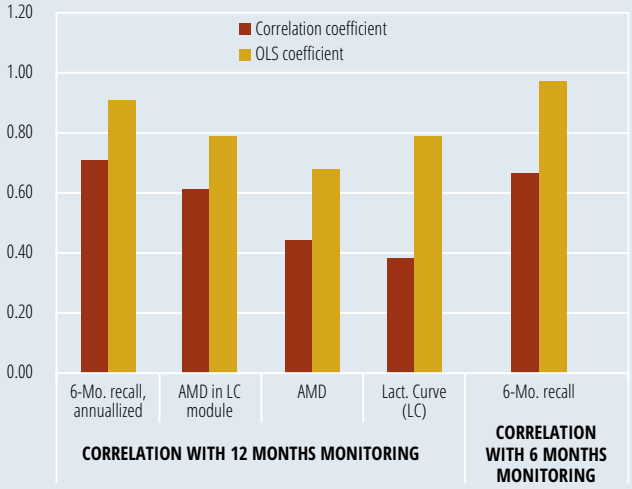
The experiment therefore revealed a clear ranking of methods in terms of their accuracy, and a clear idea of the extent to which the range and distribution of the estimates produced with each of the survey methods deviates from the benchmark value of choice.

FIGURE 3. MEASURING MILK PRODUCTION IN NIGER: BOX PLOTS COMPARING RANDOMIZED RECALL METHODS AGAINST PHYSICAL MONITORING



2 The results are discussed in full in Zezza *et al.* (2013).

FIGURE 4. MILK PRODUCTION DATA EXPERIMENT: COMPARING 6-MONTH RECALL DISTRIBUTION TO LACTATION CURVE METHOD.



SYSTEMATIC PILOTS: PASTORAL HOUSEHOLDS IN ARUSHA, TANZANIA

The above example highlights the complexity of survey design and lends itself to examining other challenges which are potentially more complicated and require different methods. Broader information needs often are required which cannot be generated by simply adjusting the survey design through refining how one specific (albeit crucial) piece of information is collected.

A critical example facing the African livestock sector is ensuring inclusion of special populations such as mobile herders (nomadic, semi-nomadic, transhumant) which are often not captured in national household surveys because of the problems posed with integrating them in the sample, and of finding them in a specific location at the time of the survey. The little data that exist on pastoralists is therefore usually the product of surveys geared specifically at surveying those populations or communities, which most likely invalidates any direct comparison with the population at large.

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BOX 5. ISSUES IN MEASURING PASTORAL ECONOMIES

Lack of panel data on pastoral production systems thwarts the possibilities of formulating investments which promote an efficient use of resources available in arid and semi-arid lands, including livestock. Whereas several studies have documented pastoralist production systems and pastoralist livelihoods in detail, the tools these studies use are time- and cost-intensive and not appropriate for monitoring trends in the pastoral economy on a regular basis. More practical ways need to be developed if Statistical Authorities are to collect, process and disseminate data and statistics on pastoral production systems.

There are at least three key issues associated with measuring pastoral economies. First, there is no standard definition of pastoralism, which may be identified on the basis of economic parameters (how much does livestock contribute to household income?), agro-ecological parameters (where is the household situated?), ethnic dimensions (to what tribe does the household belong ?), by exclusion (e.g. by defining crop and mixed crop-livestock farmers) or by combination of more than one variable. Each of the different approaches has its own advantages and weaknesses: for instance, using an economic definition could produce high variability in the number of pastoralists across the years because of rapidly changing livelihood strategies associated in response to weather fluctuations.

Second, pastoralists' regular or opportunistic movements during the year makes it difficult to set up a system of standard data collection. Trekking routes may change from year to year (nomads may even change animal movements after being informed of survey operations) and counting all animals that pass along a route is difficult; aerial or satellite surveys are powerful instruments to measure livestock populations in vast arid and semi-arid areas, but they produce little information on the pastoral economy, i.e. on their own they are an ineffective tool for designing programs and investments. Water points, which have been used as sampling units in some countries (e.g. Southern Ethiopia and Iran), are often unknown to statistical authorities and also present high seasonal variability, both in numbers and capacity of watering livestock, i.e. livestock data collected at water points may produce highly variable results across the years.

The third issue relates to data interpretation focused on pastoral people which prioritizes investment options consistent with their livelihood system. Given the multiple roles of livestock in pastoral economies, and the oftentimes opportunistic use of markets by pastoral peoples, using standard production or profit functions to identify key constraints affecting their livelihoods may lead to biased conclusions and policy indications. ■

As noted by Presser *et al.* (2004a: p. 122) pre-tests are especially lacking for special populations, which is where they are most needed given the special difficulties posed in surveying these populations. Survey challenges linked to pastoral households include two broad classes of difficulties: (1) capturing them in the sample, and (2) asking the right questions.

The experiment summarized in the following section focuses on the latter: assuming access to pastoral households, what are the priority questions? Given that the livestock management practices practiced by pastoralists (as well as many other challenges to their livelihoods) are profoundly different from those of sedentary livestock keepers (and households in general) relevant information cannot be extracted by asking them the same set of questions posed to other households.

Developing a pastoral specific questionnaire therefore requires carefully thinking about the key questions, adapting existing questionnaires from both sedentary and pastoral livestock and other living standard surveys, and putting together an entirely new questionnaire to be tested and validated before it can be applied on a larger scale. While it may not be possible to identify a 'gold standard' for comparison, one can, however, attempt to develop new sections of a survey instrument to address key questions for analysis, systematically pilot them in the field, and document the difficulties, successes and failures. Consolidating, collating and disseminating this learning can contribute towards establishing a body of knowledge that will incrementally improve survey design efforts. The objective should not be that of arriving at a blue-print, off-the shelf type of questionnaire, but rather to offer a starting point for other practitioners to adapt to the specific features, goals and circumstances of each survey.

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In the Arusha region of Tanzania, an exercise was conducted to adapt key sections of the Tanzania National Panel Survey (NPS) questionnaire for use with pastoral populations (Maasai communities, in this case). An initial draft module was developed which started from the NPS questionnaire and was then adapted to address key features which appeared not to work well with pastoral Maasai communities. The new questionnaire had a modified household roster which attempted to capture the complex organization of the Maasai household which was not adequately represented by a questionnaire built around a nuclear family. It also included a set of questions which related livestock ownership to the specific sub-households, questions on household and livestock mobility, sedentarization, grazing practices, and conditions which are not relevant to sedentary livestock keepers in Tanzania but are fundamental to interpreting the challenges to Maasai livelihoods.

While conducting fieldwork, the field team iteratively revised the questionnaire, documenting the underlining rational motivating the changes, and providing an account of how the questionnaires performed in the interviews. This was combined with a quantitative analysis of the data collected from about 200 households located in different communities with a wide range of underlying agro-ecological and socio-economic characteristics. Comprehensive results are documented in a detailed report (Loos and Zezza, 2013).

This systematic piloting of the new survey instrument provided some clear indications of the specific traits of pastoral livelihoods in Northern Tanzania that may be more amenable to inclusion in a national survey like the NPS while also revealing those that may not, or that would require considerable extra effort. Adjusting the household roster to reflect the complex structure of Maasai households, for instance, appears doable, and may have important implications for the analysis of livestock management. Table 4 shows the implications of using the Maasai definition of household (the *"olmarei"* in Maa language) versus one based on the nuclear family definition implied by the standard household definition used by the National Bureau of Statistics (NBS) in their National Panel Survey (NPS). (The latter would be identified by Maasai respondents mostly as a sub-household, referred to by its Kiswahili term, *"kaya"*). Because of the way livestock are assigned to different households members, and across sub-households, the key descriptive for the same sample would change dramatically. This would clearly have implications for any analysis of livestock management, in particular those related to animal movement, because of the way livestock is distributed across sub-households, as well

TABLE 4. TANZANIA: SUMMARY STATISTICS USING DIFFERENT HOUSEHOLD DEFINITIONS

		Self-defined *Olmarei*	NPS definition *Kaya*	% difference
Number of households		200.00	372.00	86.00
Household size		9.50	5.50	-42.00
Dependency ratio		1.31	1.18	-9.90
Female headed HH (%)		1.50	3.80	153.00
Age of head of household(years)		46.20	48.40	4.80
Head attended school (%)		28.00	23.70	-15.40
Animals	/ household	99.20	53.30	-46.30
	/capita	10.43	9.71	-6.00
TLU	/ household	23.33	12.54	-46.20
	/capita	2.45	2.29	-6.50

Source: Loos and Zezza, 2013

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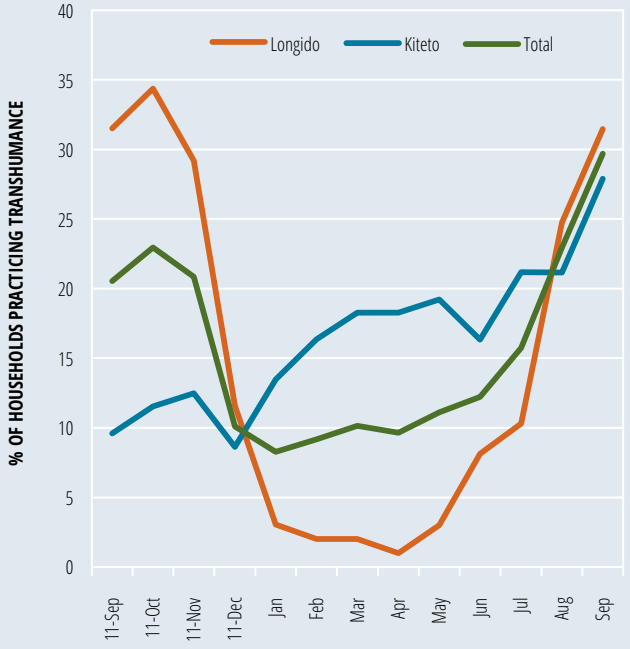
as per any per capita measure of welfare (because of the way household size needs to be computed to take into account the different eating and sleeping arrangements prevalent among the Maasai).

Gathering basic information on the extent and timing of mobility, and on the state of grazing areas also seems possible. Identifying the specific grazing areas used may be more challenging, although this may be feasible where community land use maps have been developed. Asking households in different communities about the extent, duration and mobility of households and livestock, responses were obtained that seemed to tally with the qualitative perceptions. This approach seems better able to capture the heterogeneity across households and communities (see Figure 5 for a graphic depiction of the responses).

A critical challenge to overall survey design is to ensure that all households can be found at the time of the survey. Surveys organized in two visits during a 12 month period may be more successful in reducing the number of households that cannot be contacted, in particular by understanding the expected timing of mobility so as to identify a suitable time for the second visit. This pilot has shown that it is possible to gather useful information for the analysis of pastoral livelihoods in a complex household survey, such as integrated household surveys. While it would have been quite challenging for the NPS operations to undertake such a pilot targeting such a relatively small population, the independent undertaking of the survey and the documentation and sharing of results with in-country stakeholders will increase the likelihood that the Statistical Authority will afford more specific attention to pastoral populations in future national surveys. Without such a focus, national level data will miss an opportunity to discuss policy options for the development of pastoral communities.

FIGURE 5. TANZANIA: PERCENTAGE OF HOUSEHOLDS PRACTICING TRANSHUMANCE OVER THE PAST 15 MONTHS BY DISTRICT



Source: Loos and Zezza (2013)

CONCLUSIONS

Surveys are conducted routinely on a wide range of topics in countries around the world. The amount of learning that is accumulated from each survey performed is arguably much less than what it could be. Pressed for time, resources and results, survey practitioners often draw on their own experiences, or those of their associates, as the main source of guidance.

A systematic approach to learning, as presented in this chapter, can contribute to improving the quality of the data that are generated by household surveys, and transform the learning process whereby best practices are adopted by others. This avoids reinventing the wheel every time a new survey is designed. Documentation and dissemination of lessons learned are crucial in that respect.

Targeted efforts at experimentation and documentation of innovative survey designs can have a positive impact not only on the quality of the data being produced, but also in the confidence that data users have in those data. While expert judgment and experience will continue to be an important input into designing surveys, a range of methods, drawn from experimental designs to systematic pilots, can feed into improved survey practices, generate better quality data, and contribute to innovative learning processes.

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2.3 PHYSICAL MEASURES OF PRODUCTION FOR BETTER STATISTICS: THE LIVESTOCK TECHNICAL CONVERSION FACTORS

KEY MESSAGES

Face-to-face interviews are often unsuitable for obtaining accurate data on the production level.

Physically measuring at the farm level and in abattoirs/slaughterhouses is necessary for properly quantifying production levels in traditional livestock production systems.

Unless production levels are physically measured at regular year intervals, official statistics on livestock risk being biased.

Methods to physically measure production level at farm level and in abattoirs/slaughterhouses are relatively straightforward, though they might be expensive.

INTRODUCTION

Increases in agricultural productivity, including in livestock, are essential for economic growth and poverty reduction in much of the developing world. Measuring livestock productivity, and understanding its determinants, is therefore critical to design and making investments that maximize the contribution of livestock to socio-economic development.

Livestock productivity connects inputs to outputs. Partial livestock productivity is the amount of output produced by one unit of a given production factor over a reference period, e.g. labor productivity could be calculated as liters of milk produced/hours of labor devoted to milking per cow per day; feed productivity could be computed as kg weight gain/kg of dry matter fed to the animal over a stated period of time. Total factor or multi-factor livestock productivity measures output(s) (e.g. milk, manure, transport services; etc.) per unit of a set of factors of production (e.g. animal stock, feed, water, etc.), and gives a single overall measure of productivity. Total factor productivity is calculated using indices of outputs and inputs (e.g. the weighted sum) or by some econometric technique that links output(s) to a set of inputs. Both partial and total livestock productivity measures are either based on the physical quantities of inputs and outputs (primal measures of productivity) or on price, profit and cost information (dual measures of productivity) (Chambers, 1988; Nin *et al.*, 2007).

The quality of any livestock productivity measure strongly depends on the quality of the data available to measure inputs and outputs. Data quality is typically high in research institutions or stations mandated to undertake scientific studies. It is relatively good when *ad hoc* data collection activities are undertaken for some investment purpose, such as for implementing a time-bound project in a given geographical area. It is less good, and often poor, when nationally representative livestock statistics or indicators are to be generated: limited financial and human resources devoted to data collection; limited focus on livestock in most surveys, i.e. lack of livestock data; sampling errors; non-sampling errors (e.g. improper survey livestock question formulation); and low frequency of livestock data collection, all make it difficult to generate good quality livestock productivity measures.

The consequences of not correctly measuring livestock productivity in nationally representative statistics can be serious. First, the Ministry responsible for livestock development will not be able to fully assess the returns to sector policies, including investments on the ground, which could lead to a biased allocation of ministerial resources. Second, livestock value added or the contribution of livestock to the Gross Domestic Product is unappreciated, which again could result in a less-than-optimal allocation of government resources.

This chapter presents some methodologies for improving livestock productivity indicators at country level. The focus is on the enumerator of all productivity measures, i.e. on the level of production, and in particular on parameters used to calculate so-called livestock technical conversion factors,

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which convert a measured livestock parameter to a different unit of measure: for example, 'milk yield per cow per day' allows estimating the level of milk production by only counting the number of milking cows over a given period/area.

The next section briefly reviews methods and challenges to collecting data on livestock production to generate nationally representative statistics; section three introduces livestock technical conversion factors and their role in producing good quality livestock statistics; section four presents some low-cost data collection methodologies to estimate selected livestock technical conversion factors, which have been recently applied by the Tanzanian government. Section five presents conclusions.

CHALLENGES IN COLLECTING DATA ON LIVESTOCK PRODUCTION

Four major survey instruments can be used to collect data useful to generate statistics on livestock production (see chapter 1.4):

- The agricultural census and, in some cases, the livestock census. These collate, process and disseminate data on a complete enumeration basis on a limited range of structural items of agriculture, which change relatively slowly over time. The agricultural/livestock census usually collects data on milk and egg production and, in some circumstances, on meat production.
- Agricultural sample surveys, including specialized livestock sample surveys, provide governments with comprehensive data on the livestock sector, which supplement census information. These surveys usually collect data on production levels of all major livestock products.
- Living standards measurement studies (LSMS) are multi-topic household surveys that aim to measure poverty and well-being and understand their major determinants. They collect data on livestock production, an important contributor of household livelihoods in developing countries.
- Administrative record data, also referred to as routine data, are regularly collected by national governments with the objective of planning, implementing and monitoring the delivery of public services. They often include data on livestock production levels, including of all major livestock products.

Whichever the survey instrument, there are two main methodologies of data collection. The first consists of direct interviews, whereby an enumerator visits the (farm) household or some other stakeholder and asks him/her detailed questions on some livestock production variables. The second consists of visual observations, whereby some actor, such as an extension officer or a market agent, observes (in a more or less structured way) production-related variables and fills a data spreadsheet (MLFD, 2012). Tables 5 to 8 provide examples of survey questionnaires and data sheets used by sub-Saharan African governments to collect data on livestock production levels.

Assuming that no actor has incentives to misreport, direct interviews and visual observations are appropriate to capture with statistical precision information on categorical variables which are slowly moving, such as the number of large and small ruminants owned by a household, or main water sources. They can also be used to capture, although with less accuracy, information on variables for which the respondent is likely to have some, but not full, knowledge/memory, such as the number of animals affected by a certain type of disease over the past 12 months or the amount of resources spent to treat sick animals over the reference period.

Direct interviews and visual observations, however, are not the best methods to collect data on variables which are difficult to measure: these are typically continuous variables with relatively high variability, and whose value also depends on factors that are not under the control of the household, such as rainfall. Cases in point are livestock production variables, such as meat, manure and milk production. In these circumstances, technical conversion factors are often used or should be to generate statistically robust livestock production indicators.

"Whichever the survey instrument, there are two main methodologies of data collection. The first consists of direct interviews… The second consists of visual observations."

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TABLE 5. UGANDA LIVESTOCK CENSUS 2008: QUESTIONS ON MILK PRODUCTION

Household identification number (ID)	Cattle			
	Indigenous	Exotic		Milk production (litres)
		Dairy	Beef	
Household ID				
Household ID				
Household ID				
Household ID				
—				

TABLE 6. ETHIOPIA LIVESTOCK SAMPLE SURVEY 2010/11: QUESTIONS ON EGG PRODUCTION

	None	Indigenous	Hybrid	Exotic
Laying hens				
Egg production per hen per clutch				
Average number of days per clutch				
Total number of clutches during the reference period				

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TABLE 7. NIGER NATIONAL SURVEY OF HOUSEHOLD LIVING CONDITIONS 2011: QUESTIONS ON MEAT PRODUCTION

Livestock type	How many [animals] did you slaughter in the past 12 months?												What was the average live weight (in kg) of animals that you slaughtered?	Over those months, what was the average quantity of meat that you produced?
	Number of animals slaughtered												Kg	Kg
	1	2	3	4	5	6	7	8	9	10	11	12		
INDIGENOUS														
Cattle														
Small rumin.														
Camels														
Pigs														
Poultry														
Guinea fowl														
CROSS/EXOTIC														
Cattle														
Small rumin.														
Pigs														
Poultry														

TABLE 8. TANZANIA ADMINISTRATIVE RECORDS: DATA ENTRIES ON LIVESTOCK SLAUGHTERED AND MEAT PRODUCTION

Type of Livestock	Total number slaughtered		Total carcass weight (kg)	
	This quarter	Cumulative to date	This quarter	Cumulative to date
Cattle				
Sheep				
Goat				
Pig				
Chicken (local)				
Chicken (improved)				
Others (specify)				

LIVESTOCK TECHNICAL CONVERSION FACTORS

Technical conversion factors are coefficients that convert a measured quantity to a different unit of measure. Examples of livestock technical conversion factors are:

- 'Meat per slaughtered animal', which allows calculating total meat production when multiplied by the number of animals slaughtered over a certain period in a certain area;
- 'Off take rate', which allows arriving at an estimation of the number of animals slaughtered from total livestock population data over the reference period;
- 'Milk production per cow/day', which allows estimating the level of milk production by counting the number of milking cows over a given period/area;
- 'Dung per adult cattle', which allows calculating the level of production for one of the major by-products of large ruminants, manure, by counting the adult cattle population over the reference period;
- 'Eggs per hen'; 'dry matter intake/day per animal'; 'weight gain per kg of dry matter intake'; etc. are other technical conversion factors that, if available, are useful to generate nationally representative production and productivity statistics for the livestock sector.

In order to measure the level of production of livestock products and by-products, three different levels of technical conversion factors are typically used. First level technical conversion factors allow calculating the amount of meat, offals, fat and fresh hides from every slaughtered animal; or the amount of manure and milk from every animal/milking animal. Second level technical conversion factors are used to decompose, say, meat in boneless flesh, butcher fat, salted meat, sausage, and other. At the third level, technical coefficients are used to convert, say, cattle butcher fat into animal oil, tallow and other (FAO, 2000).

In a developing country context, where self-consumption of livestock products is common and processing limited, first level technical conversion factors are of foremost importance and widely used to generate national livestock statistics. For example, in the Tanzania National Accounts, beef production is calculated by multiplying the total number of beef cattle slaughtered by 125, which is the technical conversion factor used to convert beef carcasses into kg of meat.

The 'meat conversion factors' for goats, pigs and indigenous chickens are 12, 45 and 2 kilos respectively; as for cow milk, the technical coefficient used is 1 litre of fresh milk/day per cow. The problem with Tanzania, and with most developing

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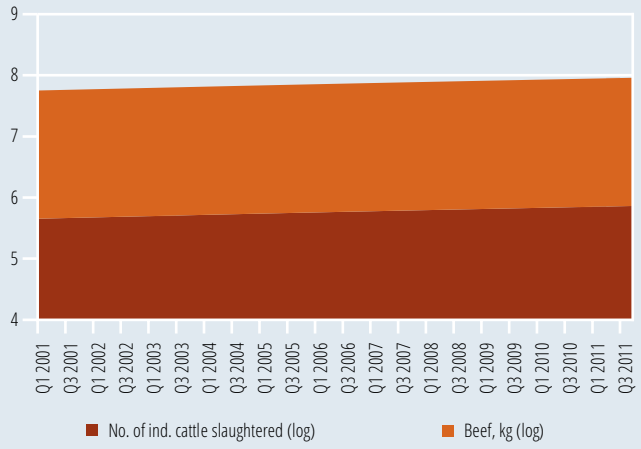
countries, is that the adopted technical conversion factors are often obsolete; calculated using data from non-representative or biased samples; taken from neighbouring countries; and/or rarely updated. The consequences for decision makers can be serious, as Figure 6 shows.

Figure 6 depicts the number of beef cattle slaughtered and the volume of beef production in Tanzania from first quarter 2001 to fourth quarter 2011, as reported in the National Accounts. Note that the slope of the two curves, and hence the distance between them, is constant over the reference period. This is so as, for the entire period, a constant technical conversion factor has been attached to carcasses to estimate beef production.

The implication is that increase in production is all accounted for by the increased number of animals slaughtered, and that likely improvements in animal productivity — which are in part reflected in the value of livestock technical conversion factors — are not captured in official statistics, which thus miscalculate the contribution of livestock to the gross domestic product. From another perspective, all policies and investments implemented by the Ministry responsible for animal resources aimed to increase beef cattle productivity, such as wider vaccination coverage and better feeding, are unappreciated in official statistics. And the latter influence the way public resources are allocated across sectors and between Ministries.

FIGURE 6. BEEF CATTLE SLAUGHTERED AND BEEF PRODUCTION IN TANZANIA, 2001–2011



Source: Tanzania National Bureau of Statistics, unpublished data

CALCULATING LIVESTOCK TECHNICAL CONVERSION FACTORS

The data needed to calculate livestock technical conversion factors, as explained above, cannot be obtained with statistical precision through surveys or visual observation, and some direct, physical measurement is recommended. This can occur at different points along the value chains but, for the purpose of calculating first level technical conversion factors, two are the appropriate sampling units:

- Farms, or households keeping livestock;
- Abattoirs and/or slaughterhouses.

At the farm level, data to calculate the following key conversion factors can be collected accordingly (MLFD, 2012):

- Milk production/day per milking animal

  Graduated transparent high-quality plastic containers can be provided to farmers, who are then required to record milk production at each milking, usually in the morning and the evening. Farmers are also to be given a record card. This is a standard methodology to estimate (partial) milk productivity.

- Manure production/day per large and small ruminants

  There are three methodologies available to measure daily manure production from large and small ruminants. The first consists of attaching a faecal bag to the animal and weighing the collected faeces at the end of the day. This method has been often used in research stations and mainly in stall-fed systems; in traditional systems, however, it is likely to influence animal 'behavior' and hence to generate biased results. The second method consists of weighing for a few days the faeces of some animal and then asking the farmers to count the number of times that the sampled animals defecate each day. The third method, which is the most labor-intensive, consists of following a sample of animals for a number of days and weighing their faeces as they defecate. The latter is possibly the most accurate method to quantify manure production per animal/day in traditional production systems.

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- Eggs/laying bird per clutching period

  A simple record card can be given to farmers to record the number of eggs produced by each laying bird, provided that she is in her clutching period. This methodology is straightforward, but farmers need also to provide information on the length of the clutching period, a pre-condition to arrive at quarterly/annual estimates of egg production.

In abattoirs/slaughterhouses, data to calculate the following technical conversion factors can be collected:

- Live weight and carcass weight of slaughtered animals; and meat, offals and fat content of carcasses.

  There are tools and equipment — such as scales and carcass weighers — that slaughterhouses use to measure live weight, carcass weight and the meat, offals and fat content of the carcass. Many slaughterhouse/abattoirs are already equipped with effective measurement tools and, in these premises, slaughterhouse managers should be easily able to record, if required, selected production parameters on a daily basis.

The above methodologies are not complex, but their implementation is challenging. First, to be meaningful for statistical, policy and investment purposes, technical conversion factors should be representative for the country as a whole and, possibly, for its major agro-ecological zones. In addition, seasonality should be captured. This has implications for both the sample size and the time length of data collection, making it expensive the estimation of statistically accurate livestock technical conversion factors (ILCA, 1990; Thomson, 2012).

Second, farmers in particular, but also abattoir/slaughterhouse managers, should be trained to properly collect the data needed to estimate livestock technical conversion factors, and be provided with equipment/tools for measuring and recording production parameters, such as a graduated plastic containers for quantifying milk production.

Third, some incentives should be given to farmers and slaughterhouse/abattoir managers for proper data collection. As a general rule, cash incentives should be avoided, as they may jeopardize future data collection activities, and in-kind incentives are to be preferred. At the farm level, these should possibly target livestock production (e.g. balanced/ supplemental feed for animals) and be provided at the end of the data collection exercise to avoid biased results. Basic equipment such as disinfectants, raincoats, knives and boots are appropriate incentives to ensure good data collection in slaughterhouses/abattoirs.

Finally, while one-off investments to update livestock conversion factors are valuable, country governments should make all efforts to ensure that livestock technical coefficients be regularly updated, a pre-condition for the efficient allocation of public resources. Updated technical conversion factors also reduce the need to collect data on livestock production through surveys or administrative records, thereby reducing the financial and human resources needed for implementing agricultural/livestock surveys and routine data collection (administrative records).

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CONCLUSIONS

Measuring livestock productivity, and understanding its determinants, is essential to design and implement investments that maximize the contribution of livestock to socio-economic development. Productivity relates inputs to outputs, and the quality of productivity measures strongly depends on the quality of the data available to measure them. These data, when it comes to producing nationally representative statistics, are often of poor quality.

Traditional methods of livestock data collection, including direct interviews and visual observation used in surveys and administrative records, are not the best methods to collect data on variables that are continuous and difficult to measure in low-income settings, such as meat, milk and manure production. In these circumstances, technical conversion factors are used or should be used to produce accurate, nationally representative statistics. These are coefficients that convert a measured livestock variable to a different unit of measure: for example, 'milk yield per cow per day' allows estimating the level of milk production by only counting the number of milking cows over a given period/area. Technical conversion factors are best calculated by physically measuring the value of selected parameters at different points along the value chains, but in most countries the value of technical coefficients is obsolete or sourced from inappropriate datasets.

This chapter presented methods to collect data to calculate key livestock technical conversion factors, namely milk production/day per milking animal; manure production/day per large and small ruminants; and eggs/laying bird per clutching period at the farm level; and to collect data to quantify live weight and carcass weight of slaughtered animals; and meat, offals and fat content of carcass in slaughterhouses and abattoirs. The methods presented are straightforward, but appropriate sampling, incentives and institutional arrangements are needed for proper data collection and the ensuing calculation of technical conversion factors. Livestock technical coefficients should be updated regularly to properly measure livestock production and productivity. This allows one to assess the effects of policies and programs on the ground and to properly estimate livestock value added, i.e. the contribution of livestock to GDP, which influences the way public resources are allocated for livestock developmental purposes.

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2.4 INSTITUTIONAL CHANGES TO IMPROVE THE QUANTITY AND QUALITY OF ADMINISTRATIVE LIVESTOCK DATA

KEY MESSAGES

Good administrative records, also called routine data, are critical for policies and investments design as they provide data at low administrative level.

Routine data are often considered of relatively poor quality, as they are collected by extension officers who are rarely, if ever, trained statisticians or trained in data collection.

Routine data, on paper, are collated on a complete enumeration basis, which make data collection extremely demanding. A sampling approach is possibly a more effective way to collect data at local level with some statistical accuracy.

Institutional experiments, whereby different methods to organize data collection at local level are performed on a small scale and their efficacy compared, are an effective way to improve the system of routine livestock data collection.

INTRODUCTION

Most livestock data publicly available in sub-Saharan African countries are collected either by the National Office of Statistics or by the Ministry responsible for livestock development. The latter, often in cooperation with local government authorities, collects livestock-related data at a low administrative level during its routine operation. These data, called routine data or administrative records, are, along with census data, the only ones that provide information at district/province or lower levels of disaggregation. For this reason, they are widely used to design, implement and monitor livestock sector policies and investments.

Routine livestock data also contributes to regional and international livestock-related information systems and/or databases, such as the Livestock Information Management System (LIMS) of the Southern Africa Development Community (SADC), the Animal Resources Information System 2 (ARIS 2) of the Interafrican Bureau for Animal Resources of the African Union (AU-IBAR), CountrySTAT and FAOSTAT of the Food and Agriculture Organization (FAO), and the World Animal Health Information System (WAHIS) of the World Organization for Animal Health (OIE). Indeed, international obligations require that African countries submit monthly, six-monthly and annual animal health/disease reports to the World Organization for Animal Health (OIE) — the reference organization to WTO with respect to trade-related trans-boundary animal diseases (TADs) — to the Africa Union-Interafrican Bureau for Animal Resources (AU-IBAR); and to some Regional Economic Communities (RECs).

Despite governments' and other regional and international institutions' wide-ranging use of routine livestock data, administrative records are often incomplete, out-of-date and unreliable. Insufficient resources, and limited skills in data-handling and processing, are the two most-cited reasons for the inadequacy of administrative records. Improvement is thus essential to promote evidence-based policy and investment decisions and implementation. Notably, the *Global Strategy to Improve Agricultural and Rural Statistics* considers administrative records to be one component of the integrated survey framework; it highlights that routine data are a key source of information for generating several indicators for agricultural statistics; and it includes administrative data as one of the priority research areas in its Action Plan for Africa.

Efforts to improve administrative records in developing countries, however, have to date been limited. But for few exceptions, such as the JICA-sponsored improvement of the agricultural routine data in Tanzania, national and international investments have mostly targeted censuses and sample

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surveys. There are thus few experiences and methodologies available to allow assessment and improvement of routine data systems. In turn, this further contributes to reduced investments in administrative records.

This paper presents a methodology for undertaking a rapid assessment of routine livestock data systems and identifies options for improvement. It has been developed by the Uganda Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and the Uganda Bureau of Statistics (UBOS), in collaboration with the FAO-World Bank-ILRI-AU-IBAR *Livestock in Africa: Improving Data for Better Policies* Project. Uganda, like several other developing countries, has a system of routine data collection that explicitly targets livestock. The next sections describe this system and present and apply to Uganda a rapid assessment methodology for livestock administrative records. A section follows that proposes actions for improvement. These proposals are intensive 'field experiments' or pilot approaches with control groups, which represent significant institutional changes in Uganda. A last section presents conclusions and recommendations.

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ROUTINE LIVESTOCK DATA COLLECTION IN UGANDA

The Directorate of Animal Resources within the Uganda Ministry of Agriculture (MAAIF) is comprised of two Departments, namely the Department of Animal Production and Marketing and the Department of Livestock Health and Entomology. The Directorate of Animal Resources is mandated to formulate and implement livestock sector policies, plans and programs, and to control and manage epidemic animal diseases. MAAIF makes use of census and survey data to fulfil its mandate, but its major source of information on livestock is administrative records. These represent the country's only information regularly available at district and lower administrative level and, therefore, are of primary importance to MAAIF.

The system of routine data collection in Uganda is structured as follows. Sub-county level Livestock/Veterinary officers are responsible for provision of extension services to rural households, and for collection of some livestock-related data during their routine work. These officers collect data according to a reporting form formulated at the district level: across districts there is no unique format used, as data are primarily collected to meet the differing information needs of District Authorities/Local Governments. On a monthly basis, the District Livestock/Veterinary Officer compiles and assembles the data gathered by extension officers in the various sub-counties and submits a pre-designed livestock data reporting form to MAAIF, through his/her respective Chief Administrative Officer. It is notable that District Authorities are not legally obliged to report to MAAIF, as they are subordinated to the Ministry of Local Government.

The livestock data report that districts compile on a monthly basis includes information under several headings:

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- 'General information', namely basic information on rainfall pattern; water availability and grazing conditions;
- 'Outbreaks of contagious diseases', including outbreaks of any of 28 major diseases, numbers of animals affected and at risk, and action taken to control/manage any outbreak;
- 'Rabies' cases, including those in humans;
- 'Vaccination', which refers to the number and species of animals vaccinated against any of 8 major diseases (CBPP, FMD, LSD, Black Leg, Brucellosis, NCD, Rift Valley Fever, CCPP);
- 'Other clinical cases handled', by species, which refers to first aid and surgical interventions, diarrhea, mastitis and others;
- 'Tick control', including number of cattle dipped; number of dip tanks available by ownership (communal or private);
- 'Dip wash testing', which reports on acaricide type, number of samples tested and the results of tests.
- 'Laboratory activities', i.e. results of analyses of blood/lymph node smears; faeces and serum.
- 'Vaccine stocks', with details on doses available and date of expiry;
- 'Internal animal movements in relation to animal laws', including from/to other districts and means of movement (e.g. foot; truck/train; or air);
- 'Artificial insemination' for four major dairy cattle breeds (Friesian, Ayreshire, Guernsey and Jersey);
- 'Veterinary regulatory activities', i.e. information on dissemination and sensitization meetings on animal-health related issues;
- 'Meat inspection', namely pre- and post-mortem inspection activities and results by species;
- 'Animal quarantine and other restrictions', including number of counties/sub-counties quarantined; number of livestock markets closed; control measure taken; etc.;
- 'Animal production', which refers to number of live animals in the district by species;
- 'Types of livestock farming systems in the district', i.e. number of animals in pastoral/communal, semi-extensive, semi-intensive and intensive production systems;
- 'Livestock markets', which collects information on number of live animals offered and sold in the different markets and maximum, minimum and average price;
- 'Hides and Skins', including salted and non-salted and kilograms produced;
- 'Staff disposition and vehicle strength', namely grade of staff and level of education; number of vehicles by type (e.g. trucks; 4WD; motorbikes; etc); and other equipment available, such as computers, GPS, refrigerators and generators.

The routine data that MAAIF collects largely target animal health and diseases, with some limited information on the livestock population (production) and on livestock markets. Indeed, almost 60 percent of the 2011/12 MAAIF budget for 'animal agriculture', excluding fishery, is allocated to 'vector and disease control measures', which basically means animal vaccination. Note that not all information in the livestock reporting format can be regularly sent by District Authorities to MAAIF: for example, new outbreaks of animal diseases do not occur every month, nor in all districts is there a functional laboratory or a quarantine station. In any case, the amount of information that districts should produce on a monthly basis is significant and should suffice to formulate and monitor the implementation of animal health-related policies and investments.

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BOX 6. ROUTINE LIVESTOCK DATA COLLECTION IN ZANZIBAR

Routine livestock data, or administrative record data, are regularly collected by the Ministry of Livestock and Fisheries (MLF) of the Revolutionary Government of Zanzibar. MLF staff work in the Central Government, the Districts and the Shehias. The first step of data collection is performed at Shehia level, where, as one of their tasks, so-called Livestock Production Assistants and Para-veterinarians collect livestock-related data from livestock keepers. These data are sent every month to the District Authority, where the District Livestock Officer and the District Veterinary Officer prepare monthly reports and send them to MLF HQs. In particular, every month District Officers submit to MLF HQs: (a) Animal Health Reports; (b) Animal Production Reports. MLF then compiles monthly Animal Health and Animal Production Reports, which cover the whole of Zanzibar. These reports are neither submitted to AU-IBAR nor to the World Organization of Animal Health (OiE).

In some circumstances, Shehia and District Officers also obtain data from Community Animal Health Workers, even though the latter are not MLF staff. Another source of data are the so-called Animal Health and Production Centres of MLF. There are about 20 such Centers in Zanzibar, which are located in the higher livestock concentration areas and provide livestock keepers with clinical, diagnostic, treatment and extension services. Finally, when there are disease outbreaks that risk spreading throughout the islands, MLF provides human and financial resources to Local Governments to control the disease. Additional data are collected in these circumstances, which can enter the monthly reports.

The Monthly Animal Health Report targets a variety of information, including: (a) disease outbreaks by type of disease and animal species (cattle, sheep, goats, donkeys, chicken, ducks, cats and dogs); (b) number of animals by species affected, treated (by type of treatment) and dead (by type of disease); (c) number of vaccinations, disease control and warm control practices by animal species and practice; (d) activities in quarantine stations (at ports and the airport), and related to meat inspections and laboratory investigations; (e) revenue collection, primarily generated by service fees (e.g. for AI or dipping) and movement permit; (f) number of staff available by gender and participation in training.

The Monthly Animal Production Report contains the following information: (a) number of livestock keepers by gender and animals owned, including cattle (indigenous and improved), goats (indigenous and improved), indigenous poultry, and layers and broilers; (b) number of farmer groups by animal species and membership; (c) animals owned by species by government farms, including multiplication units for dairy cattle and dairy goats; (d) number of animals sold, both within Zanzibar and between Zanzibar, Tanzania mainland and other countries; (e) number of animals slaughtered, yield (lit / kg) and production of cow and goat milk, beef, goat, chicken and eggs; (f) types of extension services provided (e.g. dairy husbandry practices; pasture management; animal welfare, etc.) and number of beneficiaries, as well as farmer field schools organized; (g) revenue collection, primarily from sales of pasture seeds and feed for animals; (h) number of staff available by gender and participation in training.

MLF's objective is clearly to ensure regular and good quality information on the livestock sector in Zanzibar, with a focus on animal health and production. However, the quantity and quality of available livestock data is often unsatisfactory, for a number of reasons. (a) officers in Districts and Shehias are not trained in data collection/analysis, which is one of their many tasks, and not among their top priorities; (b) Livestock Production Officers and Para-vets in Shehias collect data from the farmers they visit, which may differ from month to month; (c) while there is a common data format for MLF District staff to compile the monthly reports, at Shehia level, there is no common template, with extension officers collecting and reporting data as they prefer; (d) at local level, resources are often scarce and, therefore, Districts do not always send with regularity their Animal Health and Production Reports to MLF HQs.

MLF has plans to improve the quantity and quality of routine livestock data, including recruiting more staff and conducting staff training to establish benchmark data, and information systems. It recognizes the major challenges inherent in the generation of good quality production statistics, including information on off-take, carcass weight and milk yield per animal. Virtually all efforts to control and eradicate animal diseases have as an objective the improvement of livestock productivity. The challenge is to measure these productivity gains, and, ultimately, to contribute to improved livelihoods for livestock farmers. ■

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AN ASSESSMENT OF THE UGANDA ROUTINE DATA SYSTEM

Routine livestock data are a critical piece of information for the Ministry responsible for animal resources and, if properly collected, it could become an integral part of the statistical system. So far, however, despite ample criticism of administrative records, there have been few if any attempts to comprehensively assess routine data systems. In most cases, evaluations target specific issues of routine data systems in industrialized economies, such as the use of administrative records to identify undercounted population in the human census; or to update the survey framework by, for example, providing updated information on the dynamics of private and public sector businesses (Sheppard *et al.*, 2013).

This section first presents a low-cost methodology to assess routine livestock data and then applies it to Uganda. The proposed methodology builds on both quantitative and qualitative information and employs three measures:

- Number of data reports — A quantitative assessment of the number of statistical reports submitted by local staff and/or local authorities to the Ministry of Agriculture/Livestock versus the number of reports due. Although simple, this ratio is a good indicator of the effectiveness of the prevailing institutional architecture, including mechanisms of data collection and reporting.
- Completeness of data reports — A quantitative assessment of the completeness of the information in the different sections of the statistical reports submitted to the Ministry of Agriculture/Livestock, including the proportion of sections filled. This ratio provides an indication of the capacity of local staff/authorities to report on specific data items. Indeed, while information on some variables can be easily captured — number of vaccines administrated by extension officers — other is more difficult to gather, such as average market prices for live animals.
- Qualitative assessment — Semi-structured interviews with expert informants, including not only those directly involved in data collection and analysis, but also staff in the National Bureau of Statistics, who can provide a statistical perspective on data systems usually managed by agricultural/livestock experts.

Number of reports

Figure 7 displays the number of livestock data reports submitted by the 112 Uganda Districts to MAAIF from January to December 2012. Figure 8 summarizes the frequency of district reporting: the histogram shows a U-shape distribution as out of 112 districts, only 31, or 27 percent, regularly submitted their monthly livestock data report to MAAIF in 2012; on the other hand, another 16 districts, or 14 percent, never reported to MAAIF that year. The remaining 66 districts reported to MAAIF in a number of months between 1 and 11 in 2012. The overall reporting rate stands at 62 percent, i.e. of 112 reports expected each month — one per district — 70 were received by MAAIF in 2012. An immediate conclusion is that the current institutional architecture of data collection and reporting does not properly work.

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FIGURE 7. UGANDA: LIVESTOCK DATA REPORTS SUBMITTED BY DISTRICTS BY MONTH, JANUARY–DECEMBER 2012

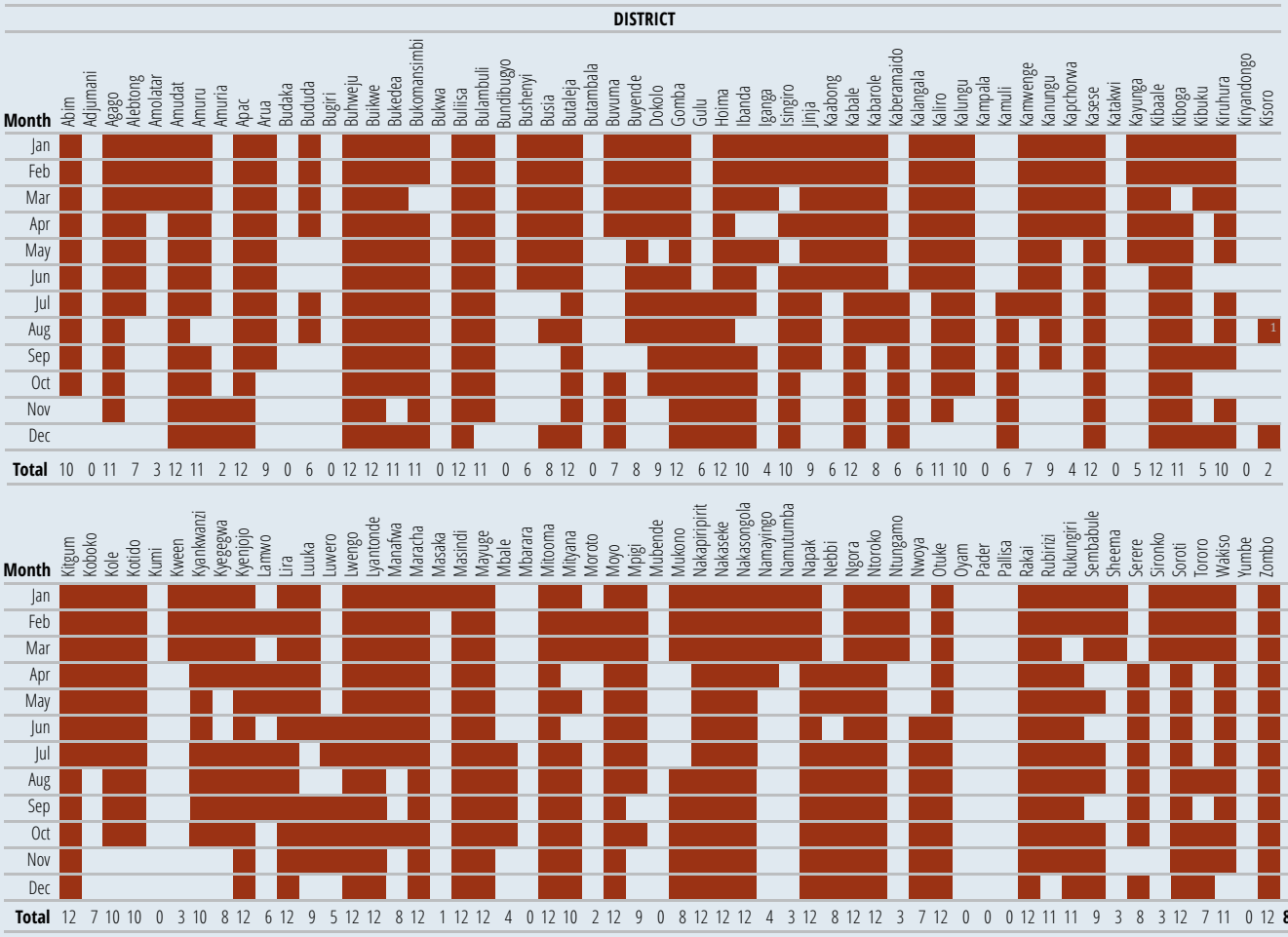

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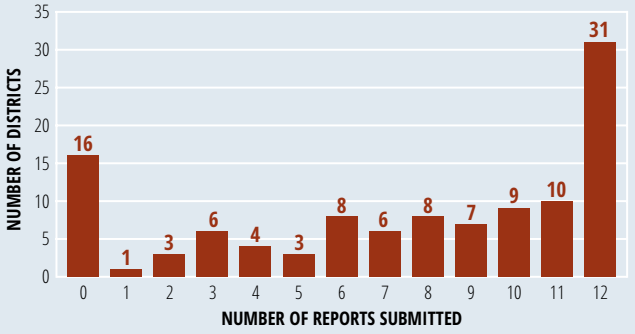
FIGURE 8. UGANDA: FREQUENCY OF DISTRICT REPORTING



Completeness of reports

The second step for assessing routine data systems is to look at the completeness of the reports received by MAAIF. As noted, the required information can be difficult to gather and assemble for data collectors and authorities at the local and national level. Figures 9 and 10 display the number of livestock data reports, by section, as a proportion of the total number of reports that should have been submitted (Figure 9), and over the number of actual reports submitted (Figure 10). In other words, Figure 9 shows the probability for MAAIF of getting the information for the data item at hand, while Figure 10 shows the probability of getting that same information conditional on selecting one of the reports submitted to MAAIF by the district authorities.

Figures 9 and 10 substantiate the evidence that the current system of routine data collection and reporting is somewhat inadequate: not only are relatively few reports regularly submitted, but those submitted are often incomplete. The most reported item is 'general information' which, as said, comprises basic information on rainfall pattern, water availability and grazing conditions: this is reported in 35 percent of expected cases, and present in 56 percent of the submitted reports. In other words, there is a probability of 33 percent of getting 'general information' from any district and a probability of 56 percent of finding that information among the available reports, with 'general information' being the most reported data item.

FIGURE 9. UGANDA: DISTRICT OVERALL REPORTING RATE

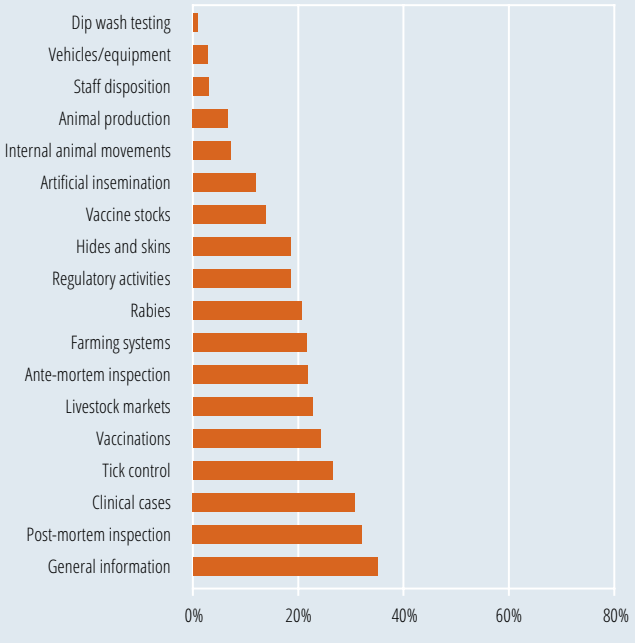
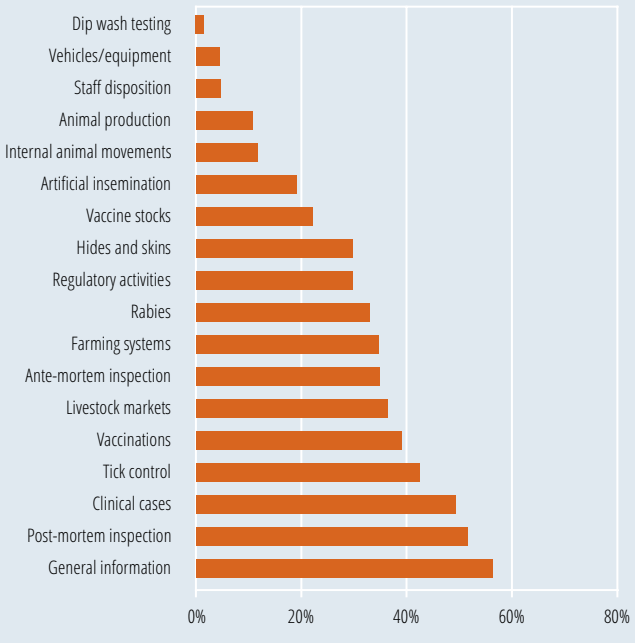


FIGURE 10. UGANDA: DISTRICT CONDITIONAL REPORTING RATE



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Qualitative assessment

A team from the Ministry of Agriculture, Animal Industry and Fisheries and the Uganda Bureau of Statistics conducted semi-structured interviews with expert informants to assess the system of routine data collection. The team travelled to three selected districts — namely Lira, Nakasongola and Soroti — which submitted all reports to MAAIF in 2012 and are located in the so-called cattle corridor, an area stretching from northeast, through central to southwest Uganda and with a high animal population density. Semi-structured interviews were conducted with extension officers, who are responsible for data collection at sub-county level, and with the district veterinary officers, who are tasked with assembly of the data gathered by extension officers and compilation of reports for MAAIF. Then discussions were held with staff from the College of Veterinary Medicine and Biosecurity, the National Agricultural Research Organization, the College of Agricultural and Environmental Science, the Animal Genetic Resource Centre and Data Bank, the Dairy Development Board and the National Drug Authority. The conclusions were:

- District authorities contend that livestock data are critical for management and planning, primarily for animal disease control and management. Indeed, in all districts data collection prioritizes animal vaccination and animal treatment, though some information is also collected on other tasks performed by extension officers and the veterinary officers, such as artificial insemination and post-mortem inspection of carcasses. Only Nakasongola district authorities mentioned animal population as a key indicator for management and planning. Only in Soroti district are data stored electronically; in Lira and Nakasongola paper forms are used.

- Extension officers lament that data collection — and other activities they must perform — involves significant movement for which they have insufficient resources, such as motorbikes, computers and fuel. Indeed, paper-based data collection should be done on a complete enumeration basis, but this is rarely, if ever the case.

- Even if extension officers had enough resources to visit all households that keep livestock in each sub-county, this would still pose a major challenge. According to UBOS data, in a typical sub-county there are about 4000 households, of which about 2400 or 60 percent on average keep some animals. This means that an extension officer, while performing his many other activities, should interview about 100 households per day — assuming he/she works 24 days a month — in addition to gathering information from other sources, such as in livestock markets and abattoirs.

"Extension officers lament that data collection — and other activities they must perform — involves significant movement for which they have insufficient resources, such as motorbikes, computers and fuel."

- Extension officers are not trained in data collection and handling, and gather their information during their daily activities. They do not follow specific rules and procedures, nor do they administer survey questionnaires to households that have livestock and other relevant stakeholders such as market authorities. Scattered direct observations are the norm.

- The livestock statistical report that District authorities submit to MAAIF includes data items that are not consistently defined. Some data reflect the routine work undertaken by extension officers, such as the number of animals vaccinated; other data are based on *ad hoc* data collection, such as data on market prices for live animals and on the livestock population; and data focus on both relatively static and highly dynamic items, such as number of staff and vehicles available in the district office and outbreaks of animal diseases. This inconsistency makes data compilation and reporting difficult.

- The College of Veterinary Medicine and Biosecurity, the National Agricultural Research Organization, the College of Agricultural and Environmental Science, the Animal Genetic Resource Centre and Data Bank, and the National Drug Authority collect their own data, such as on breeds, breeding practices and reproductive performance. These data would represent a valuable input into policy design and implementation if complemented by those collected by District authorities on a monthly basis.

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OPTIONS TO IMPROVE THE LIVESTOCK ROUTINE DATA SYSTEM

The MAAIF-UBOS assessment of the routine data system in Uganda revealed major weaknesses, which need to be addressed to ensure proper management of the livestock sector. MAAIF and UBOS duly established a small team to identify options for improvement of the routine livestock data collection system. This team based its work on four assumptions. First, any improvement in the routine data system should start from the set of core livestock indicators, as identified and endorsed by the National Agricultural Statistical Committee. These are indicators needed by MAAIF and UBOS on a regular basis and collected using their recurrent budget. They are the core indicators presented in Chapter 1.2.

Second, routine data, if collected according to sound statistical principles, could also be used by the National Statistical Authority, thereby facilitating data integration and improving the overall efficiency of the agricultural statistical system. As far as possible, therefore, statistical principles should be adopted by the routine livestock data collection system.

Third, the budget allocated to extension and data collection is limited and, most likely, will remain limited. Options to improve routine data, therefore, should attempt to simplify the current system and involve little or no increase in the current budget. Indeed, there will be transaction costs to move to an improved data collection system, but these are one-off, or *una tantum,* investment costs.

Finally, various institutional reforms can be devised to improve the routine livestock data collection system. *A priori*, however, it is difficult to identify the most appropriate and efficient reforms. Pilot implementation of alternative institutional reforms to identify the most promising options is widely appreciated as an effective way of promoting significant improvements. Based on these assumptions, and on the rapid assessment of the routine livestock data system, the following is recommended:

1. District authorities should produce monthly, quarterly and annual statistical reports to be shared with MAAIF, constructed so as to recognize demands on the time of the extension officers and the District Veterinary Officers. The monthly report will target only data related to animal diseases, including information on disease outbreaks, on vaccination and treatment, and other core activities related to animal disease management and control. This information should not be used to generate official statistics. The quarterly report will target only information on the livestock population and market prices for live animals and hides and skins. This information, if properly collated, can be used to generate official statistics. The annual report contains only information on major livestock-related physical and human resources available in the district, such as slaughterhouses, market facilities, and staff by grade. It could also contain summary tables derived from the monthly and quarterly reports.

2. Extension officers in all sub-counties should use a common collection and reporting format. In particular, one form should target the monthly information and the other the quarterly information that districts are supposed to send to MAAIF. While extension officers can collect data for the monthly report during their routine work, the information in the quarterly report requires some targeted data collection activity. Extension officers should be trained to administer questionnaires to collect these data.

3. Four pilots are suggested to implement sound statistical principles in gathering routine livestock data which are collected on a quarterly basis. The pilots build on the evidence that, as shown, data collection on a complete enumeration basis is not achievable with current human resources and, therefore, a sampling approach is needed. Sub-counties will be subdivided into enumeration areas (EAs) — a list of EAs is already available and, in most cases, one EA corresponds to one village. In each sub-county the extension officer will travel either in all, or a sample of, EAs for data collection; in the sampled EAs s/he will interview a sample of households and, depending on the case, s/he will be given an incentive for data collection, such as some free fuel. The four approaches, which are summarized in Table 9, vary because of different sampling and resources provided to extension officers for data collection. Note that in two cases the current budget should suffice to implement the proposed new systems of data collection at the country level, while in the other two some additional budgetary allocation is anticipated. To identify which of the different pilots provides better estimates of the livestock population in the country, a livestock census will be conducted in the pilot sub-counties, which will also allow building an updated frame for selecting the sampled households. Results will be compared with those from two control sub-counties, in which

the current monthly reporting systems will remain in place. Implementation of the pilots will be joint responsibility of MAAIF, UBOS and Local Government Authorities.

The implementation of the proposed pilots will provide evidence on whether or not statistical principles can be brought into the routine livestock data collection system. It will also help to identify the most appropriate institutional reform for improved routine livestock data collection. The proposed pilots target only data collection and do not include any activity related to data transfer and analysis. Finally, it is worth noting that independent of the implementation of any pilot, MAAIF can request Districts to adopt the proposed monthly, quarterly and annual livestock statistical reporting formats.

TABLE 9. UGANDA: PROPOSED PILOTS TO IMPROVE THE ROUTINE SYSTEM OF LIVESTOCK DATA COLLECTION

	Pilot 1 Sub-county 1	Pilot 2 Sub-county 2	Pilot 3 Sub-county 3	Pilot 4 Sub-county 4
EAs	All	All	Sample	Sample
Households	Sample	Sample	Sample	Sample
Training for extension officers	Yes	Yes	Yes	Yes
Resources to extension officers	No	Yes	No	Yes
Benchmark	Livestock Census	Livestock Census	Livestock Census	Livestock Census

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CONCLUSIONS

The Ministry responsible for livestock development, often in cooperation with local government authorities, collects livestock-related data on a regular basis in the course of its routine operation. These data, called routine data or administrative records, are compiled at relatively low cost and collected at ground level. They represent a critical input into policy and investment design, implementation, monitoring and evaluation, and the management of the livestock resources more generally.

There is scattered evidence that in developing countries routine livestock data are inadequate, and no standard methodology is available to assess their quality. This paper presented a methodology for a rapid assessment of the routine livestock data system, which builds both on quantitative and qualitative information. The quantitative information targets the number of available statistical reports and their completeness; the qualitative information includes semi-structured interviews with expert informants.

The methodology to assess the routine livestock data system was applied to Uganda. The current system of routine livestock data collection is inadequate because of missing information and poor quality of the data. The paper proposes to streamline the current livestock-data reporting form, by suggesting that MAAF should request District authorities to report on different items on a monthly, quarterly and annual basis. It then sketches four possible pilots to identify the first best institutional reform for an improved system of routine livestock data collection. The pilots contain three innovative elements. First, two of the proposed pilots are budget neutral, i.e. they could be implemented with a one-off investment and without the need to increase the recurrent expenditure budget. Second, they introduce sound statistical principles to administrative records by proposing a sampling approach for the routine data collection. Third, the pilots are designed to tests the relative efficiency of alternative institutional arrangements underpinning routine livestock data collection.

While designing and testing alternative pilots to improve the routine livestock data collection system in Uganda is recommended, the adoption of improved monthly, quarterly and annual livestock statistical reports — which is a no-cost action — is also expected to enhance the quality of routine livestock data.

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PART III.
LIVESTOCK DATA FOR DECISION MAKING: EVIDENCE AND EXAMPLES

3.1 ESTIMATING LIVESTOCK NUMBERS: EXAMPLES FROM COUNTING ANIMALS IN WEST AFRICA

KEY MESSAGES

A priority core indicator of relevance to governments and livestock practitioners are statistically sound — both nationally and locally — livestock numbers.

The agricultural/livestock census or agricultural/livestock surveys are potentially effective survey tools to collect data on the livestock population. Both are undertaken on a sample basis, however, which leads to biased estimates of the livestock population when the sampling units are rural households or farm households, as is often the case.

Agricultural/livestock censuses are not undertaken regularly. In the interim, models could be used to update the estimates of the livestock population.

FAOSTAT data suggests that livestock population estimates in West African countries are somewhat inaccurate.

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INTRODUCTION

Statistically sound livestock numbers are a critical core statistical indicator (see chapter 1.2) needed to formulate, implement and monitor livestock sector investments, both in the public and private sector. They also feed into the generation of other key sector statistics, including the calculation of 'livestock value added' as an input into the gross domestic product (GDP). Agricultural and/or livestock censuses and surveys are the first best source of data to estimate the livestock population in a country. However national governments rarely undertake, with regularity, agricultural or livestock censuses and, in many cases, agricultural sample surveys do not generate accurate estimates of the livestock population, mainly because of sampling issues, as revealed in chapter 1.4.

In the absence of readily available statistics, statistical agencies and livestock departments could, building on survey data, use demographic herd models to simulate the future evolution of the livestock population and its structure over time. The quality of these models strongly depends on the availability of reliable and timely data to estimate some key parameters, such as calving rate and pre-weaning mortality. These data, however, are often lacking and many countries, therefore, just apply a constant rate of growth, such as 3 percent, to available census data to generate livestock population estimates over years. The growth rate is adjusted, in some cases, to reflect weather variability, the availability of pasture and water, and on occasion, disease outbreaks.

This chapter provides evidence on how West African countries estimate the livestock population. First, it reviews agricultural/livestock censuses and surveys undertaken in West Africa since 2000, including two country case studies. It then reviews the structure of herd growth models and describes how country governments have been estimating the livestock population between censuses and surveys. The final session summarizes the main evidence and provides some recommendations for improving the agricultural statistical system in a way that produces more reliable livestock population estimates.

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BOX 7. LIVESTOCK POPULATION: A CRITICAL STATISTICS

Between January and February 2012 the *Livestock in Africa: Improving Data for Better Policies* Project administered a global online survey among livestock stakeholders (Pica-Ciamarra *et al.*, 2012). The primary objective was to identify and rank core livestock domains/areas for which livestock data/indicators are demanded. The survey targeted livestock-related data and indicators along the value chain. These include information on livestock inventories; inputs and husbandry practices; production; and consumption of livestock products, i.e. data/indicators that measure and provide information on livestock market opportunities, production and marketing-related constraints. A total of 641 respondents filled in the survey questionnaire. Respondents were asked to rank in the importance data/indicators in 15 livestock domains. Ranking is based on a 5 level rating scale (most important; important; useful; partly useful; marginally useful), while the livestock domains are:

1. Livestock inventory;
2. Change in livestock stock, which includes data/indicators on births, deaths, slaughters, marketing, etc.;
3. Animal health and disease;
4. Livestock breeds;
5. Water for livestock;
6. Feed for livestock;
7. Housing for livestock;
8. Labor force devoted to livestock;
9. Animal power, which primarily includes data/indicators on the use of animals for draught power and for hauling services;
10. Meat production;
11. Milk production;
12. Egg production;
13. Production and use of dung, including but not only as manure;
14. Hides & skins production;
15. Consumption of animal source foods.

Under each domain quantity and price data can be collected to generate various indicators, including value indicators (quantity × price). A specific question on the importance of getting price information was added, given price data's relevance to formulating economically sustainable investments. Over 83 percent stakeholders consider getting price data as most important or important.

Respondents identified six core livestock domains, which are considered as most important or important by at least 80 percent of the sample. Beyond prices, these include data/indicators on animal health and disease; meat production; livestock population; feed; milk production; and consumption of animal foods. Ranking in domains is similar across all groups of stakeholders. ■

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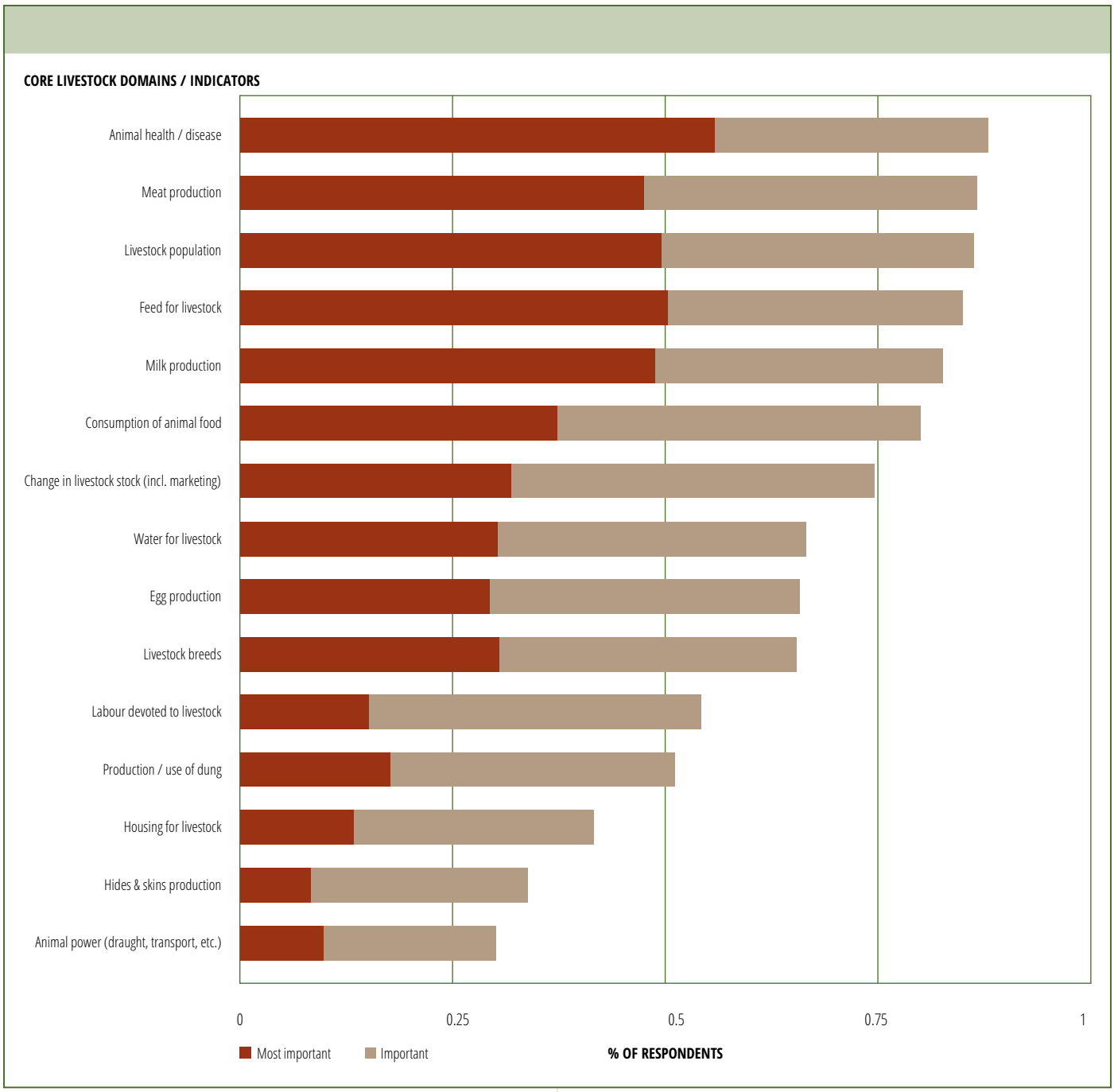

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AGRICULTURAL AND LIVESTOCK CENSUSES AND SURVEYS IN WEST AFRICA

Two main methods are used in developing countries to collect data on the number of animals and estimate livestock populations. These include, as detailed in chapter 1.4, agricultural and/or livestock censuses and nationally representative agricultural/sample surveys. Due to budget constraints, however, country governments often undertake agricultural and/or livestock censuses on a sample basis, which reduces the difference between censuses and surveys to the sample size — larger in the case of the census — and to the length of the questionnaire — longer in the case of sample surveys.

Table 10 lists the agricultural/livestock censuses and surveys implemented in West Africa since 2000.[3] Since the year 2000, agricultural/livestock censuses and surveys have been implemented in 7 out of the 16 West African countries, including Burkina Faso, Cape Verde, The Gambia, Guinea, Ivory Coast, Mali and Niger. At the same time, two countries plan to annually undertake sample agricultural/livestock surveys, notably Burkina Faso and The Gambia, though these surveys are not administered with regularity. In virtually all cases, data collection was implemented on a sample basis.

3 Sources of information are the FAO World Census of Agriculture, both from 2000 and 2010, and the International Household Survey Network (IHSN), which maintains the most comprehensive catalogue of household surveys undertaken in developing countries since the late 1800s.

TABLE 10. AGRICULTURAL/LIVESTOCK CENSUSES IN WEST AFRICA: 2000–2012

Country	Year	Type of survey	Sample size
Burkina Faso	2006/10	General Census of Agriculture	Livestock data collected between January 2008 and January 2009 from 7,500 households.
Cape Verde	2004	General Census of Agriculture	Data were collected from May to July 2004. Complete enumeration of all holding was carried out.
Gambia	2002	Agricultural Census	Data were collected from July to September 2002 from a sample of 666 dabadas.*
Guinea	2000/01	Agricultural Census	Data were collected from January to December 2001 on a sample basis.
Ivory Coast	2001	National Census of Agriculture	Data collected from January to August 2002; sampling method to collect information from stallholder farmers; large farms were fully enumerated.
Mali	2004/05	General Census of Agriculture	Data were collected from June 2004 to March 2005 from 10,000 smallholder farmers; modern holdings were fully enumerated.
Niger	2005/07	General Census of Agriculture and Livestock	Data on livestock were collected from a sample of 10,500 agro-pastoralists; water pointes were samples to count transhumant and nomadic livestock.
Burkina Faso	regularly	Permanent Agricultural Survey	In 2007, data were collected from 5,648 households, from July to December.
Gambia	regularly	National Agricultural Sample Survey	In 2005/06 data were collected from a sample of households between May 2005 and August 2006.

* Group of persons who pool their agricultural resources together, usually headed by one person who takes management decisions.

Sources: FAO, World Census of Agriculture 2000 and 2010 rounds (***www.fao.org***) and International Household Survey Network (***www.ihsn.org***)

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Table 10 implies that estimates of livestock numbers in West Africa countries are not updated regularly, nor are they necessarily reliable. In all cases, estimates are biased not only by non-sampling errors but also by sampling errors, because the household — the ultimate sampling unit — might keep or not keep animals.

Country case study: Niger

In 1974, the Niger Government, in an effort to increase immunization coverage and improve livestock availability during vaccination campaigns, abolished the tax on livestock and made vaccination free and compulsory. To identify vaccinated animals, part of the ear of each vaccinated cattle was cut, which also allowed for a better estimation of livestock number in the country and facilitated the estimation of yearly changes in herd structure. The veterinary services estimated that about 90 percent of cattle were vaccinated during any vaccination campaign conducted between 1974 and 1994. This estimate presumably generated a fairly accurate overview of the animal population in the country. Since 1995, however, with the withdrawal of the state in providing free vaccinations, the vaccination rate has dropped drastically from 90 to 12 percent, making it impossible to estimate cattle numbers using this method.

In 2007/2008 the Government of Niger, assisted by the international community, undertook the General Census of Agriculture and Livestock, which covered all eight regions, 36 departments and the three communes of Niamey. This coverage provided data at three levels of government (national, regional and district) including for three types of livestock systems; i.e. sedentary, transhumance and nomadic livestock (Republique du Niger, 2007b).

- Counting sedentary livestock. The sedentary livestock census was conducted on the basis of a primary sample consisting of 700 enumeration areas (EAs), in which two types of livestock keepers were identified: agro-pastoralists and livestock-only producers. The latter were mainly located in peri-urban areas. A sample of 15 households in each EA were randomly selected, for a total of 10,500 households. Enumerators conducted face-to-face interviews to collect information on livestock.
- Counting transhumant livestock, which are animals — mainly large and small ruminants — seasonally taken to pastures following standard trekking routes, both internal (within the country) and external (cross-border transhumance, usually towards Benin, Burkina and Nigeria). Along the trekking routes there are permanent wells and ponds where livestock are taken to water. Enumerators, positioned at a sample of water points, were responsible to directly count the animals and, to avoid double counting or omissions, they also issued a certificate of census to the livestock herder.
- Counting nomadic livestock, whose movement is largely unpredictable. However, given that animals are taken to water points regularly, these were used as sampling points. In particular, water points were classified in three layers — including bore holes, wells and surface water — and a sample of 1,223 were selected to which enumerators were posted for three to five days to directly count the animals. To avoid double counting, the livestock herder was issued a certificate of census.

Different questionnaires were drafted to collect information on sedentary, transhumant and nomadic livestock, including one specifically targeting camelids.

Country case study: Burkina Faso

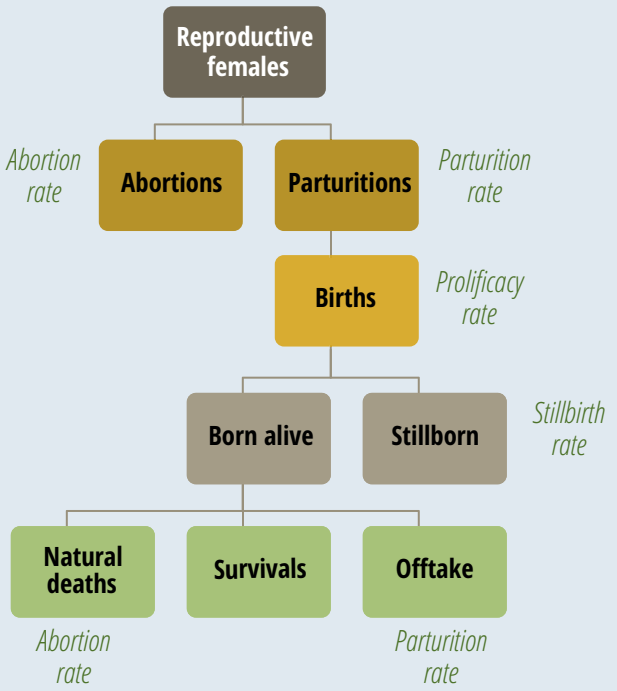
The Government of Burkina Faso undertook the General Census of Agriculture between 2006 and 2010. The previous one was administered in 1993. The Census aimed to fully measure agriculture; generate a sampling frame for subsequent agricultural surveys; and favor the establishment of a permanent agricultural statistical data collection system, also targeting livestock. Data from the Census are expected to improve the quality of the Burkina Faso Agricultural Permanent Survey (*Enquête Permanente Agricole*, EPA), which produces estimates of the agricultural production on an annual basis, including forecasts by province and post-harvest estimates. The ultimate objective of the EPA is to provide policy makers with key information on the food security situation in the country. The first EPAs were implemented in the early 1990s and the survey still remains a major source of agricultural information for the country (MAHRH, 2009).

- The EPA 2007/08 sample consisted of over 5,648 households located in 706 villages in 45 provinces throughout the country. The number of villages selected in each province was proportional to the population of the province at hand. Within each village, eight farm households were randomly selected, independent of the size of the village.

Data were collected by 706 enumerators, supervised by 72 local statisticians, 12 regional supervisors, and a coordination team at central level.

- The EPA comprises a core fixed module, which is a questionnaire focused on collecting basic information on a regular basis on current and anticipated harvests for major crops. It also includes rotational modules, which are implemented depending on the circumstances. These modules target information on agricultural production; extension services; livestock populations; agricultural inputs; prices, etc.
- The 2007/08 livestock module of the EPA included 18 questions. Questions are asked on livestock ownership, by animal species and sex. Species included are cattle, sheep, goats, pigs, mules, horses, chicken and other animals, such as ducks and guinea fowl. Information is then collected on change in stock over the last season due to births, deaths, sale and other (e.g. given away as gift). The earnings from animal sales are quantified, including a question on their use. Finally, questions are asked about livestock-related equipment owned by the households, such as animal-drawn carts.
- The results of the EPA are aggregated at provincial level and published in an annual publication whose priority focus is more on agricultural production for food security than on agricultural/livestock statistics per se. Even if livestock statistics were to be generated using the EPA data, these might not be accurate, as seminomadic and nomadic animals are not well accounted for in the survey.

FIGURE 11. ANIMAL LIFE CYCLE AND BASIC DEMOGRAPHIC PARAMETERS



THE LIVESTOCK POPULATION IN BETWEEN CENSUSES AND SURVEYS

One of the major constraints to generating accurate estimates of livestock populations in West Africa is the lack of regularity in undertaking agricultural/livestock censuses and surveys. This requires statistical authorities, and the Ministry responsible for livestock, to estimate the livestock population, based on most recent census/survey data, using set rate increases for different animal species. Figure 11, elaborated from Lesnoff *et al.* (2011), shows the basic parameters which are, in principle, needed to estimate with accuracy the changes in the livestock population, starting from the same base year.

There are three major methods that can be used to estimate all, or part, of the above demographic parameters, and hence estimate the livestock population in between censuses and surveys. These are the method of 'tracking the herd'; the method of 'follow the animals'; and retrospective surveys.

- Method of 'tracking the herd.' This is a simple form of monitoring, whereby over one or more years, investigators monitor change in a randomly selected sample of herds. Investigators regularly visit the herds (e.g. fortnightly or monthly) and document all critical changes in herd structure between two successive visits, including changes in calving, mortality, livestock use and any purchases of new animals.
- Method of 'follow the animals'. This method targets the animals (not the herds) and is the reference method for demographic data collection in the tropics. An investigator identifies all animals kept by a sample of households, most often using ear tags or microchip injections at the base of the neck. Investigators then visit the households

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regularly and document all critical changes in key demographic parameters, such as changes in calving, mortality, livestock use and any purchases of new animals.

- Retrospective surveys are based on the memory recall of selected livestock raisers. Under this method, the enumerator's role is to count the animals in the herd at the time of the survey and then to ask questions on all demographic events (births, natural deaths, slaughtering, loans, purchases, etc.) that have occurred over the reference period. Depending on the animals at hand, the reference period might differ. This method is similar to the progeny history technique in which, with reference to each adult female animal sampled, the producer is asked how it entered the herd, then about the offspring to which it gave birth. Information on the sex and disposition is solicited about each offspring in turn. Recall methods often lead to approximate results — particularly when questions are asked on short-cycle animals and using a long recall period — and, as such, country are always advised to regularly undertake agricultural/livestock censuses and surveys.

Evidence

Country governments seldom make use of statistical methods to estimate herd demographic parameters. First, the methods of 'tracking the herd' and 'follow the animals' are costly to implement on a regular basis. Second, retrospective questions are infrequently included in survey questionnaires and, when they are, they are rarely, if ever, analyzed to generate the coefficients needed to model herd growth. In practice, national governments simply apply some given growth rate to the livestock population, which is adjusted as new agricultural census/survey data become available.

Growth rates of the livestock population are, in the best cases, derived from estimates of the livestock population at two different points in times, such as two consecutive censuses. When information on the livestock population is available only for one year, information on growth rate is taken from neighbouring countries and expert informants. In both cases, estimates of the livestock population are rarely accurate, particularly when governments do not regularly update

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population estimates or review the elements influencing population growth rates.

Table 11 and 12 review year-to-year growth rates in the large ruminant and small ruminant numbers from 1990 to 2010 as obtained from FAOSTAT for all West African countries, with the exception of Liberia, Sierra Leone and Saint Helena. In the tables, two elements are highlighted. The light grey cells identify instances of three or longer-year period in which the large ruminant/small ruminant population was estimated to grow at exactly the same rate: this occurred in 13 instances in the case of cattle, and 15 in the case of small ruminants. The dark grey cells report instances of major positive or negative changes in the animal population, defined as those of over 10 percent on a year-to-year basis. These type of events occurred 15 times for large ruminants and 16 times for small ruminants. However, it should be emphasized that the ability of livestock professionals to estimate the livestock population at the time 't +1' remains one of the major challenges for the statistical services in West Africa, even when relatively good data are available.

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Overall, the two tables are illustrative of the weak capacity of governments in West Africa to regularly monitor changes in the livestock population. It is highly unlikely that between 1990 and 2003, the cattle population of Niger grew at a constant rate of 3.0 percent per year; or that the cattle population of Guinea grew at 6.7 percent per year from 2000 to 2010. Similarly, it defies credibility that in Cape Verde the large ruminant stock increased by 23, 19, 16 and 16 percent in the four years spanning from 2004 to 2008. Some of the growth rates estimated for the small ruminant population seem likewise unreliable: in Nigeria the sheep and goat population increased by 2.5 percent per year in every year from 2004 to 2009, and in Ghana at 4.2 percent per year from 2006 to 2010. In The Gambia, the small ruminant population is revealed to have increased by 43, 14 and 23 percent from 2000/01 to 2002/03, which would imply a doubling of the sheep and goat population over a four year period.

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TABLE 11. YEAR TO YEAR CATTLE POPULATION GROWTH RATE IN WEST AFRICAN COUNTRIES, 1990 TO 2010

	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	00/11
Benin	0.7	4.9	-0.1	12.9	-15.5	19.6	3.5	1.9	4.9	7.1	3.8	2.5	2.5	2.5	2.4	2.7	2.6	2.8	2.4	2.6	2.6
Burkina Faso	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	-21.2	2.0	2.0	46.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Cape Verde	-15.3	7.9	1.8	1.8	1.8	14.5	0.1	5.4	-1.8	-2.3	0.0	2.3	-0.8	2.2	23.6	19.0	16.2	16.1	1.7	2.2	1.1
Côte d'Ivoire	3.3	3.1	2.1	2.2	2.2	2.2	2.3	-2.7	2.2	0.0	2.2	2.2	2.0	2.0	2.0	2.0	2.0	2.0	2.3	0.5	0.1
Gambia	4.1	0.7	0.7	0.8	0.7	0.8	0.7	0.7	0.7	0.8	-11.2	1.0	21.3	3.0	0.5	0.7	0.5	1.2	2.9	-1.6	-6.2
Ghana	4.4	-2.9	0.8	1.6	2.5	2.6	1.0	1.0	1.2	1.1	1.0	1.1	1.1	1.1	1.0	-1.0	1.0	1.4	3.3	1.1	3.0
Guinea	8.4	8.4	8.4	8.4	8.4	5.2	5.2	5.2	5.2	6.7	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	-4.8
Guinea B.	0.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.6	0.0	1.0	0.0	1.9	3.8	4.4	4.4	3.5	3.5	1.3
Mali	1.9	0.7	1.0	1.2	1.4	1.7	2.0	2.2	2.5	2.8	3.1	3.3	3.7	4.0	4.3	4.6	5.5	10.1	3.0	3.0	3.0
Mauritania	3.7	-14.3	0.0	-8.3	1.0	1.0	20.6	3.0	5.8	3.0	3.0	-0.1	2.3	3.1	2.5	0.5	0.0	-2.7	1.4	0.1	1.2
Niger	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.1	5.9	6.0	6.0	6.0	6.0	6.0	-2.7
Nigeria	0.5	0.5	5.1	0.5	0.8	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	3.5	1.1	0.9	0.9	0.9	0.9	-2.6	17.8
Senegal	3.0	2.5	3.5	2.5	1.4	2.5	1.0	0.5	0.5	2.0	2.5	-2.1	0.7	0.7	1.7	1.5	0.8	1.5	1.6	1.6	1.0
Togo	-2.1	-1.6	-1.5	-1.5	-10.9	7.4	24.9	0.7	2.5	-1.5	1.0	2.1	0.2	1.8	3.4	0.8	0.1	-0.1	1.7	0.6	0.6

TABLE 12. YEAR TO YEAR SHEEP/GOAT POPULATION GROWTH RATE IN WEST AFRICAN COUNTRIES, 1990 TO 2010

	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	00/11
Benin	3.4	-9.1	-1.0	13.2	-3.0	4.9	1.6	0.7	5.5	4.3	2.0	3.0	2.4	2.8	1.0	2.9	1.7	4.6	-0.7	4.3	2.2
Burkina Faso	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Cape Verde	13.0	8.2	8.2	-5.9	-15.0	-3.0	0.7	5.1	-3.1	-2.1	0.0	1.7	0.9	30.4	9.3	8.7	7.8	7.4	7.4	7.5	1.5
Côte d'Ivoire	2.3	2.5	2.5	2.6	2.5	2.5	2.5	1.6	2.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.2	1.3	0.5
Gambia	19.2	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	42.7	14.0	22.7	-0.8	3.0	2.9	5.3	3.6	3.7	1.3	-8.1
Ghana	2.7	-1.7	1.6	1.4	-4.4	12.9	7.2	3.0	6.3	4.1	2.6	3.0	6.9	2.0	6.4	2.5	4.2	4.2	4.2	4.2	4.8
Guinea	5.0	5.1	5.2	14.0	7.3	6.4	6.4	6.4	6.4	7.8	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	-10.9
Guinea B.	3.3	7.5	5.0	2.9	1.9	2.7	2.7	2.6	2.5	-0.8	0.8	0.0	1.6	0.0	30.8	7.6	7.1	7.1	6.9	6.9	4.3
Mali	-10.5	0.5	0.8	1.2	6.3	2.9	3.1	9.4	9.5	7.9	8.1	5.0	5.0	5.0	0.0	5.4	8.5	8.1	7.1	5.0	5.0
Mauritania	3.5	-3.4	3.5	0.0	0.2	17.2	1.6	8.5	10.2	4.5	4.5	4.5	0.5	0.3	0.0	0.0	0.0	-9.0	5.0	4.0	0.6
Niger	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	4.3	3.8	3.2	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	-5.4
Nigeria	2.0	2.7	4.0	9.0	8.2	7.6	10.1	8.3	8.5	7.0	8.0	2.5	2.4	2.4	2.5	2.5	2.5	2.5	2.5	4.6	1.4
Senegal	5.0	4.0	4.5	4.5	2.1	4.2	3.9	3.5	3.5	1.1	3.0	-2.7	1.7	2.1	2.8	2.8	2.2	2.8	2.6	3.5	0.7
Togo	-19.6	-25.0	-9.4	-8.0	-20.6	46.9	23.2	7.9	8.0	8.1	1.8	3.6	3.5	-0.9	9.5	3.4	1.6	1.4	3.7	2.5	1.2

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All of these recommendations, many of which have been proposed over the past two decades, make little sense if resources are limited or not available at all, which is often the case for countries in West Africa and other developing regions. A practical recommendation is therefore proposed for the National Statistical Authorities and the Ministry responsible for livestock to look at systematically integrating livestock data generated by existing nationally coordinated surveys.

CONCLUSIONS

Estimates of livestock numbers represent one of the most critical core indicators for stakeholders, both in the public and private sector. Indeed, accurate information on the number of animals in the country are necessary for the Ministry responsible for livestock to formulate, implement and monitor sector policies and for the National Statistical Authority to estimate livestock value added, a key component of the GDP. At the same time, the private sector is interested in investment in the sector because demand for livestock products is anticipated to dramatically increase on the continent in the coming decades.

A cursory review of how the livestock population is estimated in West African countries illustrates that there are serious gaps. First, there are no countries in the region which have regularly undertaken agricultural censuses over the past two decades. This is clearly the 'gold standard', namely the best option to estimate livestock numbers. Furthermore, when agricultural censuses are implemented, these are sample surveys which might generate inaccurate statistics on the livestock population, particularly when the distributions of animals and that of the farming population over the space are markedly different. Second, according to available information, only 2 out of 16 countries in West Africa plan to regularly undertake sample agricultural surveys which can also be used to estimate livestock numbers. Finally, in the absence of a regular flow of livestock numbers data, governments tend to apply a constant rate of growth that is calibrated on a baseline year to update their estimates of livestock populations. Apart from not having an adequate baseline (nationally representative statistics on livestock numbers), countries have no frameworks for estimating herd performance, e.g. the evolution of herds, because of gaps in accurate and periodically monitored livestock population-related parameters.

Several recommendations can be proposed to improve countries' quantity and quality of data on livestock numbers. These include the regular undertaking of agricultural censuses with some sampling adjustments to reduce errors when the objective is to estimate livestock numbers; and the periodic implementation of specialized livestock surveys, including in settled, semi-nomadic and nomadic areas, which require different survey tools. Additionally, the routine data collection system — which includes the data collected by government officials in their routine operations — could be enhanced, as proposed in chapter 2.4 for Uganda. Better demographic parameters are needed to estimate changes in the livestock population starting from a base year; this could be facilitated through long term linkages between governments and research institutions which carry out animal based monitoring over several years in selected areas.

All of these recommendations, many of which have been proposed over the past two decades, make little sense if resources are limited or not available at all, which is often the case for countries in West Africa and other developing regions. A practical recommendation is therefore proposed for the National Statistical Authorities and the Ministry responsible for livestock to look at systematically integrating livestock data generated by existing

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nationally coordinated surveys. The National Statistical Authority routinely undertakes a variety of surveys that often target agriculture and, within agriculture, livestock. Examples include Household Budget Surveys and Living Standards Measurement Surveys which, as chapter 1.4 illustrates, also contain information on livestock. The National Statistical Authority also updates on a quarterly basis estimates of the gross domestic product, and the livestock value added therein. Generating livestock value added necessitates information on livestock populations and its change over the previous quarter; on the level of production and use of inputs. The Ministry responsible for livestock is the major livestock data stakeholder in the country, with significant incentives to access and utilize available livestock-related data. The Ministry also collects livestock data in the course of its routine operations, e.g. when it implements a vaccination campaign.

It is recommended that the National Statistical Authority and the Ministry responsible for livestock:

- examine the questionnaires of all surveys undertaken in the country over the last 15 years that include targeted questions on farm animals;
- identify how and if the various surveys can generate useful information to estimate the livestock population, and on other key livestock-related variables;
- attempt to improve the current estimates of the livestock population using available data, while also identifying low-cost options for improvements, such as adding or rephrasing a question in the survey questionnaire;
- establish consistency between the survey questionnaires, e.g. by ensuring that questions are formulated in the same way in different surveys; generating complementarity between different surveys, e.g. by using the same sampling unit; and other.

It is believed that low-cost marginal changes in the current system of agricultural data collection, if jointly supported by the National Statistical Authority and the Ministry responsible for livestock, can on their own generate improvements in the current livestock population estimates. That said, agricultural/livestock censuses and surveys remain the first-best option to collect data to accurately estimate the livestock population.

3.2 PEOPLE AND LIVESTOCK: LIVELIHOOD ANALYSIS USING THE LIVESTOCK MODULE FOR INTEGRATED HOUSEHOLD SURVEYS

KEY MESSAGES

Livestock contribute in multiple ways to households' livelihoods, including through the provision of cash income, food, manure, draft power and hauling services, savings and insurance, and social status.

Living Standards Measurement Studies, especially those with a comprehensive module on livestock, are the best source of information for quantifying the contribution of livestock to household livelihoods, including both its monetary and non-monetary value.

Accurate measures of livestock's contribution to households' livelihoods are nevertheless difficult to achieve, both because of the difficulties of properly measuring and valuing some inputs (e.g. feed from road hedges) and some outputs (e.g. draught power).

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INTRODUCTION

An absence of and inadequate data on the contribution of livestock to national economies and to household livelihoods contribute to the sector's marginalization by policy makers. Even when data are available, these are often underutilized either because they are inaccessible; disseminated in an untimely fashion; unavailable in appropriate formats; or because they cannot be usefully linked to other data sources that would deepen their analytical potential. A lack of investment focused on improving the quantity and quality of livestock statistics hampers the allocation of productive resources towards the sector, which leaves its potential untapped to reduce poverty and contribute to economic growth.

This chapter reveals that data collected through implementation of the livestock module for multi-topic or integrated household surveys, presented in chapter 2.1, provide an unprecedented opportunity to enhance understanding of livestock's role in the household, in particular its contribution to livelihoods. The livestock module for multi-topic, or integrated household surveys, consists of a set of livestock questions which can be included in the survey questionnaires of living standards measurement studies, typically administered to a nationally representative sample of households, as illustrated in chapter 1.4. Integrated household surveys capture information on household characteristics and on a range of production and consumption activities. This generates a portrait of household characteristics and behavior and facilitates an analysis of the relationships and causalities between livestock and livelihoods, as measured by different indicators, such as poverty, education, resilience, health and other (Davis *et al.*, 2010: Zezza *et al.*, 2009).

The following sections illustrate how strategic indicators of key relevance to the sector can be derived through an analysis of the livestock module for integrated household surveys. A review of these indicators improves our understanding of the role of livestock in the household economy and facilitates sector development through strategic interventions, either through policy or investment. First, appropriate measures of

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livelihoods linked to livestock are identified; then categories of livestock keepers and their husbandry practices are characterized by specific indicators; followed by a review of the role of gender in livestock keeping. The two final sections provide some suggestions for data analysis and highlight the usefulness of this analysis in the conclusions.

IMPROVED MEASURES OF LIVELIHOODS

A critical development issue is to properly measure the contribution of livestock to household livelihoods. Answering this question gives an appreciation of how much the different types of households, including the poor, benefit from their animals, and to what extent livestock represent a pathway out of poverty for the less well-off.

The contribution of livestock to household livelihoods cannot be derived from traditional LSMS data. This is because survey questionnaires often do not include information on livestock inputs, but only ask questions on livestock outputs, thereby overestimating livestock income. They also do not collect information on livestock by-products, such as manure, or the non-monetary services provided by livestock, such as hauling services and draught power, thereby underestimating the contribution of livestock to household livelihoods (see chapter 1.4). The newly developed livestock module for multi-topic household surveys includes detailed questions on assets, inputs and outputs and is, thereby, anticipated to improve the way the contribution of livestock to household livelihoods is assessed. In particular, the data can be used to measure:

- The net recurrent household livestock-derived income for the reference period, which is the difference between the value of livestock production and the value of inputs used for maintaining the animals. Outputs also include non-monetary services, such as draught power and hauling services. Depending on the objective of the analysis, the value of food for self-consumption and the value of family labor can be incorporated into the analysis.
- The insurance, credit and social value of livestock, which result from the potential of being able to sell the animals when there is a need (e.g. drought in case of insurance; investment in case of credit; weddings in case of social status). The benefits of insurance and/or credit and social status, therefore, are related to the value of the animal, a question which is asked in the livestock module.
- Changes in the embedded value of the animals, as the module collects information on variances in the herd structure over the reference period. However, the data only allow capturing value changes associated to the maturation of animals (a heifer that becomes a cow) and not weight gains/losses of each animal in the herd over the reference period.

CATEGORIES OF LIVESTOCK KEEPERS

The role of livestock in households and its contribution to poverty reduction needs to be reviewed within the context of the households themselves; consequently categories of households have to be generated. Data from the livestock module embedded within integrated household surveys can be used to produce several indicators — such as income, expenditure or an asset-index — that allow differentiating households by their livelihood level and clustering them in different groups. Income and expenditure terciles/quintiles are often used to cluster households, but one can also differentiate households between poor and non-poor, with poverty defined according to national or international poverty lines. In general, it is useful to generate a criterion (or a set of criteria) to categorize households into more or less homogeneous groups (in some way akin to a typology) that can assist in looking beyond the indicators' averages and into the heterogeneity across households. The following are some possible household typologies that can be generated using the available data:

- Livestock owners. These are defined as those households that own and raise their own animals, which is the most common situation in smallholder settled farming systems.
- Livestock keepers. These are defined as those households that own livestock and/or raise livestock on behalf of some other households. Indeed, there are circumstances in which the manager of the herd is not necessarily the owner of the animals.
- Livestock managers. These are defined as those households that only keep animals on behalf of some other households. This is, however, an uncommon practice.

Beyond differentiating households on livestock ownership, e.g. whether they own/raise animals, the data can be used to generate categories based on herd and flock size (number of large and small ruminants and number of birds) and on herd composition (sex and age of animals). To facilitate analysis, livestock numbers are aggregated, using a Livestock Unit (LU), which corresponds to an agreed upon live weight. In the tropics, the Tropical Livestock Unit (TLU), the equivalent to 250 kg live weight, is used to standardize live animals by species mean live weight. LU conversions factors notably have some drawbacks: they aggregate household animals by weights and not value, and therefore have limited market relevance; and they assume that there is little heterogeneity within animal species, disregarding differences in breed, sex, age and health status of animals. However, the approach provides a convenient method for quantifying a wide range of different livestock types and sizes in a standardized manner, and it is widely used in the literature. To quantify herd composition, some diversity index could be constructed, which takes into account the number and the composition of species in the herd.

The livestock module data also allows the grouping of households according to their market-orientation, which is a critical piece of information for the formulation of livestock sector policies and investment. Below, two possible ways of grouping farmers according to these criteria are presented:

- Subsistence-oriented livestock farmers: these are households that do not regularly sell surplus meat/milk/egg production and, therefore, derive a marginal share of their agricultural/total income from livestock.
- Market-oriented livestock farmers or livestock specializers. These are households that — contrary to subsistence-oriented livestock farmers — regularly sell some surplus production and derive a large, if not the largest, share of their agricultural/total income from livestock.

Finally, the livestock module also includes a question on the household rationale for owning/keeping animals, including sale of adult/young animals; sale of livestock products; food for the family; a risk mechanism for coping with unexpected events (such as drought, crop failures, family emergencies); draught power; manure; transport; wealth status; savings; breeding, etc. The information generated from this open question could be used to construct additional categories of households since targeted investments/ policy implementation can only be successful and have a development impact if the incentives provided correspond to household priorities.

INPUTS AND OUTPUTS

Traditional agricultural surveys and living standards measurement studies include limited information on livestock-related inputs and outputs and usually target a small number of households, with the consequence that the results are not nationally representative of the smallholder livestock sector. The implementation of the livestock module for multi-topic household surveys can partly fill this gap, as it collects information on breeding practices, type of animal housing, feeding practices and water access, access to a variety of animal health services — such as vaccination, deworming and curative treatment — use on family and hired labor, and on major livestock products and by-products, such as meat, milk, manure and hauling services.

- First, the data allow a broader perspective of households' major husbandry practices, for example by calculating the number and share of households that purchase feed, maintain shelters for their animals, have access to veterinary services, etc.
- Second, the data facilitate a more detailed analysis of household access to natural resources. For example, information is collected on the main sources of water for animals: borehole, dam, well, river, spring, stream, constructed water point, rainwater harvesting, and other; and on major feeding practices: only grazing, mainly grazing with some feeding, mainly feeding with some grazing, and only feeding.
- Third, the data allows for the quantification of some, but not all, of the inputs used. For instance, the module includes questions on the quantity and value of the feed purchased; on the payment for different types of veterinary services and the costs incurred for breeding animals.

Documenting husbandry practices of individual households is important, but the quantification of corresponding outputs assists in a better appreciation of potential development support. The livestock module for multi-topic household surveys generates information on:

- The number and value of the live animals sold;

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- The quantity of meat, milk, eggs and other major products generated by the household over the reference period;
- The quantity of livestock products sold and self-consumed;
- The use and sale of animal dung and the use and sale of animal power, including for draught power and transport.

This information, complemented with data on inputs, potentially generates an empirically based and targeted estimate of the benefits derived by households keeping animals. These benefits are both monetary and non-monetary. While some, such as the value of livestock sales, are easily quantifiable, others, such as improved nutrition level due to increased intake of animal source foods by household members, or higher crop yields due to increased manure availability, are more difficult to measure, but equally important for the livelihoods of households.

The role of marketing and access to marketing channels for livelihoods can also be analyzed using data from the new livestock module. Information is requested from respondents on where they sell their animals, in which kind of outlets (at the farm gate; at buyer's house; on the road to market; in small local markets or large markets; at the abattoir and other). In addition, they are questioned as to whom they sold their animals/livestock products (e.g. to relatives; local consumers; private traders; a marketing organization; butcher or other). This information is useful in formulating policies, as it provides indications on the extent of livestock holders' market integration and, hence, on their likely response to market-related policies.

WOMEN AND CHILDREN

Gender division of labor in livestock systems varies according to country, culture, religion and socio-economic variables. But women generally play an important role in the livestock economy and in the household. This is revealed through questions focused on the care and management or transformation and marketing of certain livestock products. There

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is evidence, for instance, that both men and women harvest and transport feed, chaff fodder, water, etc. In general, milking, cleaning of sheds and the processing and sale of milk is mainly done by women. Children are also involved in husbandry practices, such as in grazing animals, fetching feed and water, and milk collection and processing. Analysis of household data also confirms that boys and girls have different roles in tending livestock, with girls generally more involved in general livestock care than in herding.

Available household datasets allow differentiating the household on the basis of the gender of the household head (male/female) and detailing household composition. The livestock module presents an opportunity to deeper investigate the role of women and children (and men) in livestock rising.

- The section on ownership includes questions on who owns and who keeps the various animals: respondents are asked to identify members of the household responsible for each task at hand, such as milking or selling animals.
- In the section on water and feed, questions target the responsibilities of the various household members for feeding, watering, and herding the animals. In the milk production section, focus is placed on understanding the role of household members in milking the animals. The module data should facilitate a rough quantification of the man-month devoted to different tasks.
- Finally, questions are asked on household decision making, in particular for selling animals/animal products and for using the earnings.

The additional detail provided by the data from the livestock module can facilitate a better appreciation of the role of different household members — and in particular women and children — in livestock farming and can also provide some rough indications on the man-month/hour-day spent on tending animals by different household members. This could presumably better inform investments which target labor saving technologies/innovations on a household level.

MOVING FROM DATA TO ANALYSIS

The enhanced data available from the revised livestock module can be analyzed from a variety of perspectives, dependent on the interest of the user. However, the unique value of this improved data is to better estimate the contribution of livestock to livelihoods, including household income; the implied 'capital asset' value of animals (including insurance, credit and social value); and livestock production. Second, the data can be used to generate a picture of the smallholder livestock farming system. In particular, livestock-keeping households could be grouped according to one or more criteria and typologies of households established. Then the various dimensions of livestock ownership, husbandry practices and outputs can be reviewed to better understand whether they differ by typology of livestock-keeping households. For instance, for each typology of household one can tabulate:

- Livestock ownership, i.e. herd size and composition;
- Use of different livestock inputs, including quantities and values, e.g. access to basic inputs and services, such as animal vaccination;
- Production level of different livestock products, including sales;
- Use of animal products, including for self-consumption and sale;
- Use of animal by-products, such as draught power and hauling services.

Third, for the different typologies of households potential correlations can be hypothesized and tested between household-related and livestock-related variables. For example, comparisons can be made with non-livestock-keeping households to determine whether livestock ownership could influence other variables which have broader development implications. Examples include:

- Gender of head of household and herd size/composition;
- Household composition, including women and children, and herd composition, hypothesizing that women and children play a key role in livestock raising;

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- Livestock ownership, by species, and land ownership, based on the assumption that keeping land facilitates access to feed for the animals;
- Livestock ownership and credit access, contending that livestock can be used as collaterals for loans;
- Livestock ownership and nutrition, assuming that households keeping animals can have some direct access to the protein and micronutrient available in animal source foods;
- Livestock ownership and children education/health conditions of family members, as animals are known as a source of cash in time of need;
- Livestock ownership and access to market, positing that livestock are used as means of transport and surplus livestock products cannot be easily stored.

Finally, analysis of the data can be undertaken with the objective of identifying the causal relationships between different variables. Data collected in the context of multi-topic household surveys are appropriate to better understand the determinants of household poverty and well-being. The data can also be used to investigate the determinants of livestock productivity. Examples of questions that the data can possibly answer are:

- Do livestock significantly contribute to household livelihoods?
- Which households are more likely to escape poverty from investment in livestock-keeping?
- What are the major determinants of livestock keeping?
- Are there significant differences in livestock keeping between male-headed and female-headed households?
- Does household composition affect herd size and composition?
- Does livestock ownership/production contribute to food security through increased intake of animal protein?
- Does livestock ownership facilitate access to formal/informal credit?

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Given relatively small sample sizes, data from these surveys are not suitable for generating nationally representative statistics on certain indicators such as livestock herds. However, they allow an in-depth look at certain aspects of the importance of the livestock within households and its contribution to rural livelihoods. It offers empirically derived insights into smallholder livestock production systems.

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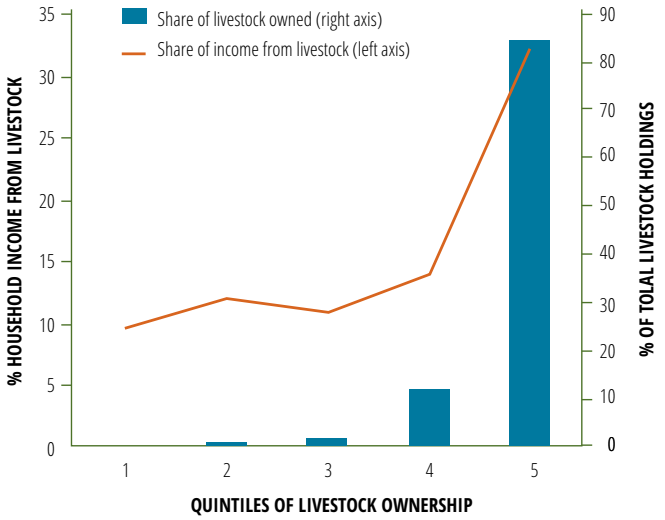
BOX 8. LIVESTOCK AND LIVELIHOODS IN TANZANIA

The Tanzania National Panel Survey (NPS) is a unique, and as yet largely underutilized, source of knowledge and information on rural Tanzania's economy and living standards. It is a nationally representative survey regularly conducted by the National Bureau of Statistics (NBS). Consequently it is much richer in data on the rural economy than previous living standard surveys carried out in Tanzania, thus allowing a much more detailed snapshot of households compared to what has been possible to date. Its first round, on which this text-box is based, was carried out in 2008–09. Since then, the survey has been implemented every two years (2010–11 and 2012–13). Analysis of the 2008–09 NPS shows that sixty percent of rural households in Tanzania engage in livestock keeping, earning an average of over 20 percent of their income from livestock, while also benefitting from other livestock uses (e.g. traction, manure). In aggregate, large ruminants dominate, accounting for over 80 percent of total livestock holdings when measured in Tropical Livestock Units (TLUs). Cattle ownership is, however, less common and more clearly linked to wealth than ownership of smaller livestock. Conversely, poor goat herders have flocks of similar size, or larger, than those of rich ones. Meanwhile, poultry ownership is very common place. From a household livelihood perspective, the importance of poultry emerges clearly alongside that of cattle: the average livestock-keeping household holds 44 percent of the total poultry birds in the country. In particular, the poorest 40 percent of rural households rely essentially on small numbers of poultry, with goats becoming more important among the somewhat better-off households, and cattle dominating among the richest 20 percent of rural households.

One issue emerging from the analysis is the high degree of concentration in livestock holdings, with the top 20 percent of livestock keepers holding over 80 percent of livestock assets (as measured by animal numbers in TLU).

Interestingly, levels of per capita expenditures do not change significantly across quintiles of livestock ownership, whereas herd size and structure does, with a particularly steep gradient in the top quintile, suggesting that there is a small core



of relatively larger livestock owners who are substantially different from the rest. This is confirmed by the fact that households in the top quintile earn about a third of their income from livestock, as opposed to 10–14 percent of income in the other quintiles.

Results show that women are relatively disadvantaged in terms of livestock ownership, particularly for cattle: this effect is strongest among poorer households. Where women do own livestock, they appear to be as market oriented as are men, if not more so, due to their role in the marketing of milk and milk products.

The NPS data allow going beyond livestock production to look into patterns of consumption of products of animal origin. The picture that emerges is one of substantial disparities in livestock product consumption between rural and urban areas and between different income groups. Overall, one can argue that that as average incomes in Tanzania continue to increase, the demand for livestock products on the domestic market will expand, offering good opportunities for livestock producers to increase incomes (Covaburrias *et al.*, 2012). ■

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CONCLUSIONS

Living standards measurement surveys provide an up-to-date portrait of living standards and livelihoods in a country. Where they provide the most insights, however, is in their ability to move beyond national averages to focus on how households' income sources, productive activities, access to basic services, market participation, access to assets, and a host of other socioeconomic variables vary across households. When sufficient attention is given to livestock at the survey design stage, such national data can be very useful for assessing livestock's role in household livelihoods.

Use of the livestock module for multi-topic household surveys, details of which are presented in chapter 2.1, is anticipated to produce a more complete understanding of smallholder livestock production systems. In particular, the collected data, as illustrated in the Tanzania example, will provide an unprecedented opportunity to appreciate if and how livestock contribute to livelihoods; to critically review the husbandry practices of different categories of livestock keepers, the typologies of which can be refined based on different criteria; to undertake analysis of the correlations between a variety of livestock-related and livelihoods-related variables; and to understand some of the determinants of livestock production and productivity.

To facilitate the availability and further analysis of basic livestock statistics, a livestock module has been developed and included in the ADePT software platform of the World Bank[4]. This improved data availability will strengthen analyses which identify the heterogeneity across households, thus moving beyond the broad brush stereotypes which are often used to characterize the livestock sector. It should, however, be noted that national household surveys, being based on population sampling frames, usually fail to capture the large-scale intensive sector, which in some countries or for some species can form a considerable portion of the sector. Depending on the sampling size and strategy of the survey utilized, it is also necessary to recognize that specific populations groups, which may be in small in number relative to the national population but hold a considerable share of the national herds, may not be adequately represented in the sample.

4 ADePT uses micro-level data from various types of surveys, including multi-topic household surveys, to develop publically available sets of tables and graphs for a particular area of economic research. Livestock is now included as one of the data sets.

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3.3 DATA INTEGRATION TO MEASURE LIVESTOCK AND LIVELIHOODS IN UGANDA

KEY MESSAGES

There are no datasets which, on their own, suffice to generate all necessary information for effective livestock sector policies and investments.

Integrating data from different surveys is an effective way to generate information on livestock, which goes beyond the indicators produced using data from individual surveys.

Critical for effective data integration is a common master sample frame for agriculture and the implementation of an integrated survey framework.

Integrating data from the Uganda Livestock Census and the Uganda National Panel Survey allows estimating per capita livestock income and the share of income from livestock at sub-county level.

INTRODUCTION

Evidence-based policies and investment decisions that support an efficient and equitable development of the livestock sector cannot be based on one only source of data. As chapter 1.3 illustrates, there are several steps that lead to the formulation of policies and investments and, in many circumstances, more than one data source should be simultaneously used to improve the quantity and quality of information underpinning any decision. Data integration, which consists in utilizing data generated from different datasets, is a cost-effective way of ensuring data availability that feeds national data systems into more informed livestock sector policy and investment decisions.

The *Global Strategy to Improve Agricultural and Rural Statistics* (World Bank, 1011) recommends that countries, to achieve data integration, develop a unique master sample frame for agriculture; design and implement an integrated survey framework; and make results available in a common data management system. A unique master sample frame ensures that the statistical units (e.g. the farm; the household) are the same for all surveys, so that data targeting different items originating from different surveys can be jointly analyzed.

This chapter presents the use of Small Area Estimation (SAE) techniques as an effective tool to integrate data from different sources, and in particular to combine livestock-related information from sample surveys, censuses and other data sources. SAE techniques have, in the past, been mainly used to generate food consumption-related maps at high level of disaggregation. SAE, however, can be also applied to livestock mapping to provide policy makers with reliable and spatially-detailed information on livestock and livelihoods, given that small area estimates of poverty are being increasingly used to target anti-poverty programs (see Hentschel *et al.*, 2000; Alderman *et al.*, 2001; Simler and Nhate, 2005 among others). Beyond policy-decision support, the results of this chapter demonstrate how integration of different data sets can greatly enhance spatial analysis.

This chapter generates estimates of household income in Uganda from livestock activities (and its share of total income) at low level of disaggregation by integrating data from the 2009/2010 Uganda National Panel Survey and the 2008 Uganda National Livestock Census. Maps are generated that provide a finer spatial disaggregation of statistics than that obtained through the use of survey data alone. The following section presents the methodology and the data used; results are then presented, followed by concluding remarks.

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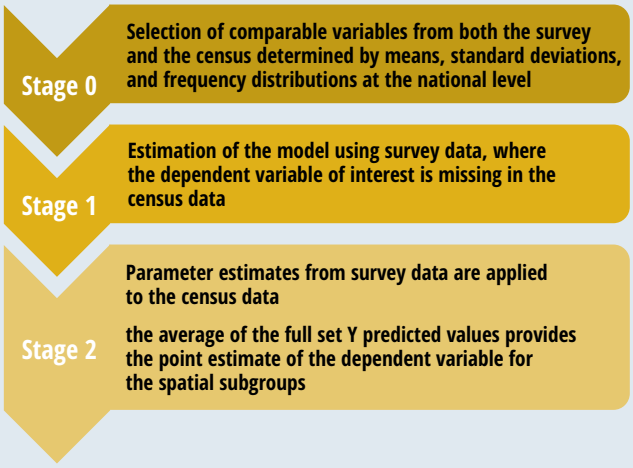
"Through the integration of survey and census data, decision makers could benefit from the detailed information in the survey and the large sample size of the census to analyze variables at a higher spatial disaggregation than would be possible with the survey alone."

METHOD AND DATA

Surveys usually collect detailed information from a sample of households: the sample size is usually sufficient to provide accurate statistics for the country as a whole, or some regions, but not to yield statistically reliable estimates at lower levels of disaggregation. At the same time, census data have a large enough sample size to generate accurate statistics at low level of disaggregation, but only provide basic information on the (sampled) households. Through the integration of survey and census data, decision makers could benefit from the detailed information in the survey and the large sample size of the census to analyze variables at a higher spatial disaggregation than would be possible with the survey alone.

The Small Area Estimation (SAE) techniques integrate data from censuses and household surveys with the objective of producing reliable estimates of priority indicators for small areas where that information is not available. The methodology underpinning the concept of SAE is relatively straightforward and, in the case of livestock, could be undertaken using the following process. First, comparable livestock-related variables need to be selected from both the survey and the census in terms of different statistical measures. The objective is to select a variable around which other data from the two surveys can be harmonized. Second, an estimation model is fitted in the survey data, where the dependent variable is missing in the census. Third, the estimated parameters are used to predict the missing livestock-related information in the census data which are available at local level. The steps are outlined in Figure 12. The method is explained in greater technical detail in Elbers *et al.* (2003).

FIGURE 12. STAGES FOR INTEGRATING CENSUS AND SURVEY DATA USING SAE



Two datasets are used for this analysis. The 2009/2010 Uganda National Panel Survey (UNPS) collected information on 2,975 households from 322 Enumeration Areas (EAs). By sampling design, the survey is representative at national level, plus the strata of (i) Kampala City, (ii) Other Urban Areas, (iii) Central Rural, (iv) Eastern Rural, (v) Western Rural, and (vi) Northern Rural. Data were collected in two visits, one for each cropping season, over a twelve month period. For the purpose of the analysis, the sample is narrowed to 2,375 households, as 45 households reported incomplete information and 555 households had moved, of which 521 are urban.

The other dataset incorporated in the analysis, the 2008 Uganda National Livestock Census (UNLC), collected data from 964,690 rural holdings in all 80 districts of the country during a single visit during the month of February, 2008. The UNLC is not a full enumeration census but a sample-based one, and is representative at the district level, which is the level of interest in the SAE. Given that the average sample size at the sub-county level is adequately large (around 1,000 households), results are also reported at this lower geographic administrative level. Nonetheless, the limited amount of information collected in the 2008 UNLC is a constraint on the number of explanatory variables in the estimation model (see chapter 1.4 for content of different survey types).

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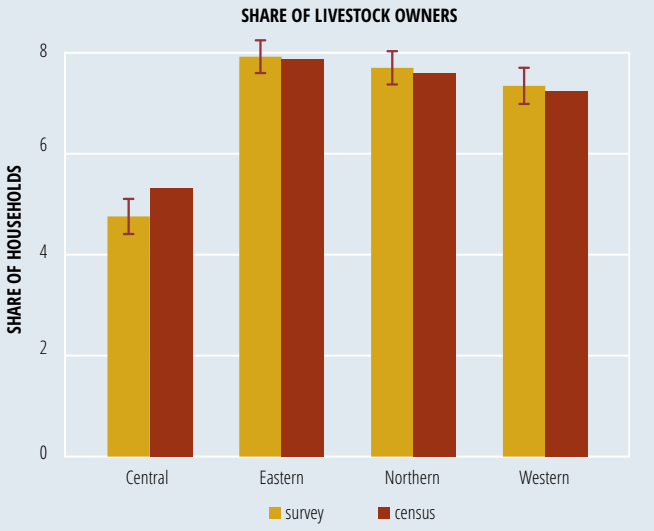
The predictors used include: land size (separately by agricultural, pasture, and other land); number of livestock heads by type (disaggregated by indigenous and exotic bulls, cows and calves, poultry, small ruminants); average weekly egg and milk production; age and gender of the household head; the use of household-hired agricultural labor; area covered by each agro-ecological zone and the Normalized Difference Vegetation Index (NDVI)[5] at the sub-county level.

Figure 13 shows the comparison of the share of households rearing livestock by region in the survey and the census. Within each region, the prevalence of livestock owners is not statistically significantly different between the census and the survey. The Figure also highlights the importance of livestock, as the prevalence of livestock owners in Uganda is relatively high in all regions, with a national average of around 70 percent.

FIGURE 13. UGANDA: PERCENTAGE OF HOUSEHOLDS OWNING LIVESTOCK BY REGION: 2009/10 NPS and 2008 UNLC (with 95% confidence interval)



5 It is an indicator assessing whether the observed area contains live green vegetation or not. Negative values of NDVI (values approaching -1) correspond to water. Values close to zero (-0.1 to 0.1) generally correspond to barren areas of rock, sand or snow. Lastly, low, positive values represent shrub and grassland (approximately 0.2 to 0.4), while high values indicate temperate and tropical rainforests (values approaching 1).

RESULTS

Three models are estimated on the 2009/10 UNPS and fitted. In the first model, the densities of large ruminants at the sub-county level are predicted and then compared to actual values in the census. This model is used to test the reliability of the prediction method used. In the second model, the dependent variable is the log of per capita livestock income (expressed in 2005 international Purchasing Power Parity dollars); and, finally, the third dependent variable is the share of total household income from livestock. The latter two models are the core of the analysis, since they estimate dimensions (livestock income) not captured in the census but collected in the survey.

One of the main results of the analysis is that, by virtue of survey-to-census prediction, it is possible to derive higher spatially-disaggregated maps than using the survey alone. Figure 14 displays the actual densities (no. of livestock/square kilometer) of large ruminants from the survey and census, as well as the predicted density into the census. Some important elements emerge:

- First, what from the survey appear to be homogeneous regions, once disaggregated to the sub-county level through the census, becomes a more detailed and scattered picture.
- Second, the density range is wider in the census than in the survey, as in the latter the distribution is composed of four values — one for each region — as averages of sub-county values within each region.
- Third, and foremost from a policy perspective, the census map is more meaningful for targeting purposes.

The first model also tests the reliability of the methods used in conducting this analysis. Figure 14 reveals that the actual and the predicted densities of large ruminants from the census is very close to the predicted one using the SAE method. This result offers an insight as to how SAE can be a viable and reliable method to estimate spatial distribution of missing information through prediction.

While the density of large ruminants in the census resembles closely the distribution from the survey, the model fitted on the log of per capita livestock income in purchasing power parity is less able to predict missing information into the census. Figure 14 shows maps from the survey and the census for the estimated model.

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FIGURE 14. UGANDA: DENSITY OF LARGE RUMINANTS ACTUAL FROM SURVEY (LEFT), ACTUAL FROM CENSUS (RIGHT), AND PREDICTED FROM CENSUS (BELOW) AT REGIONAL AND DISTRICT LEVEL

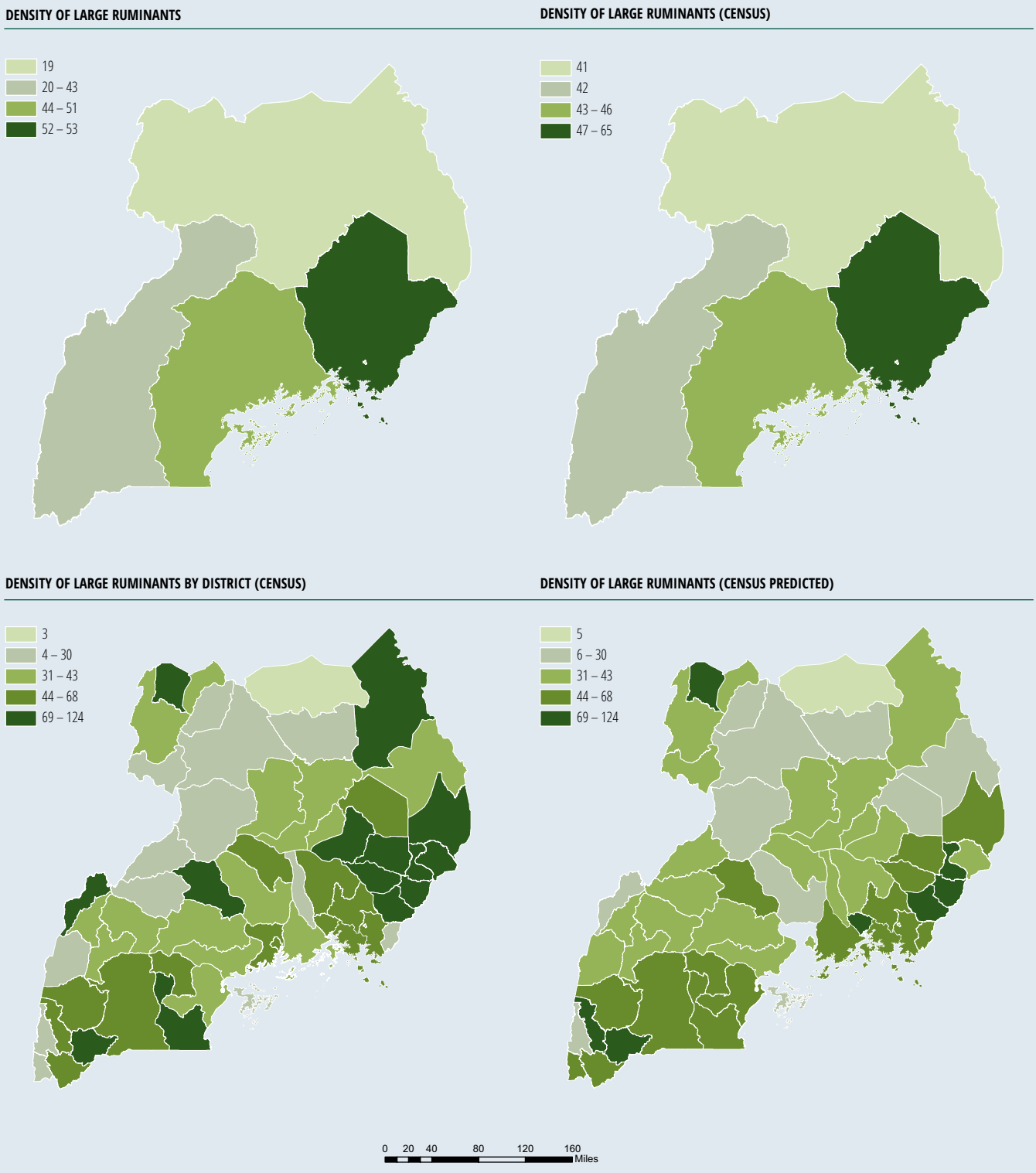

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FIGURE 15. UGANDA: PER CAPITA LIVESTOCK INCOME ACTUAL FROM SURVEY AND PREDICTED TO CENSUS

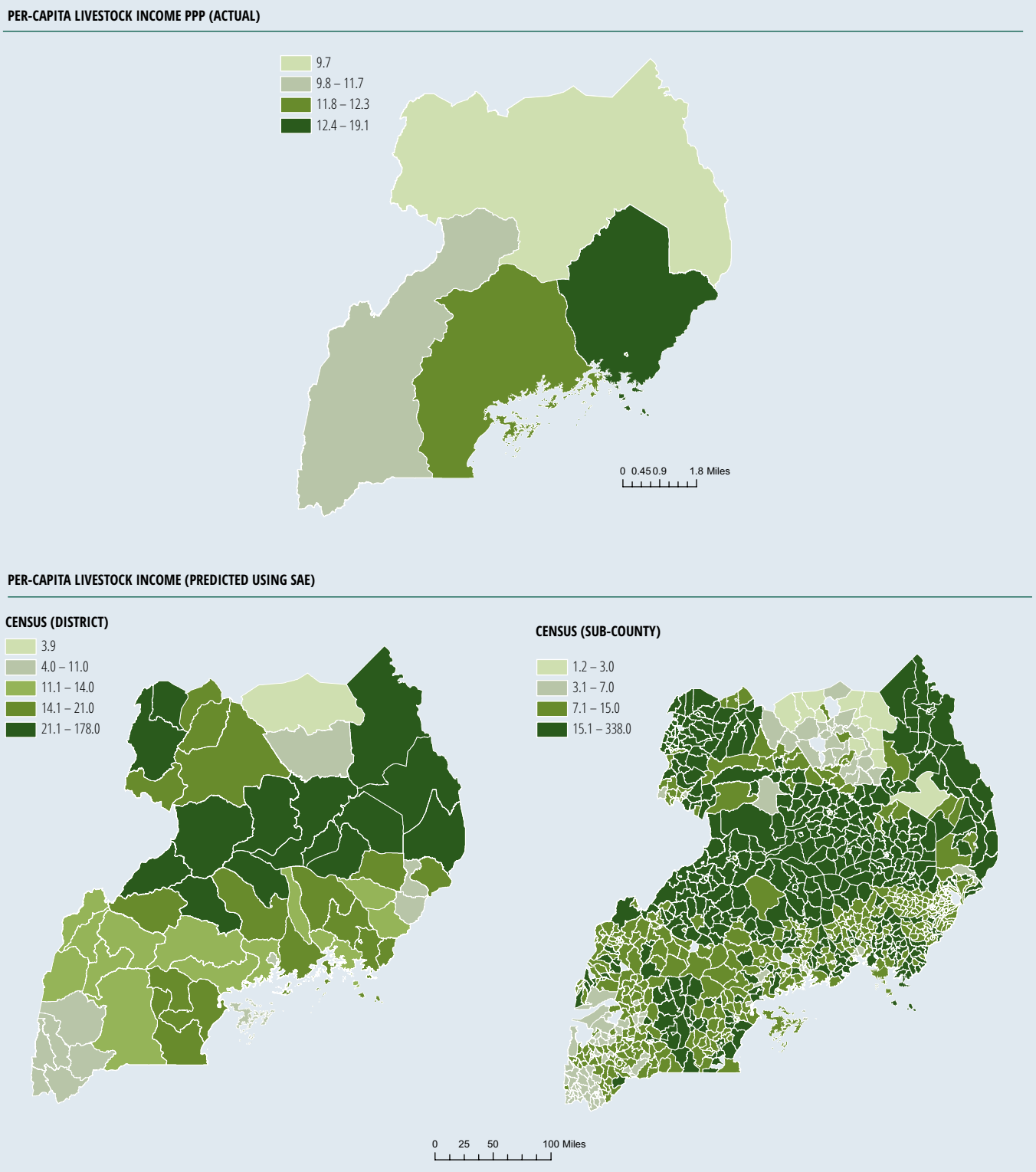

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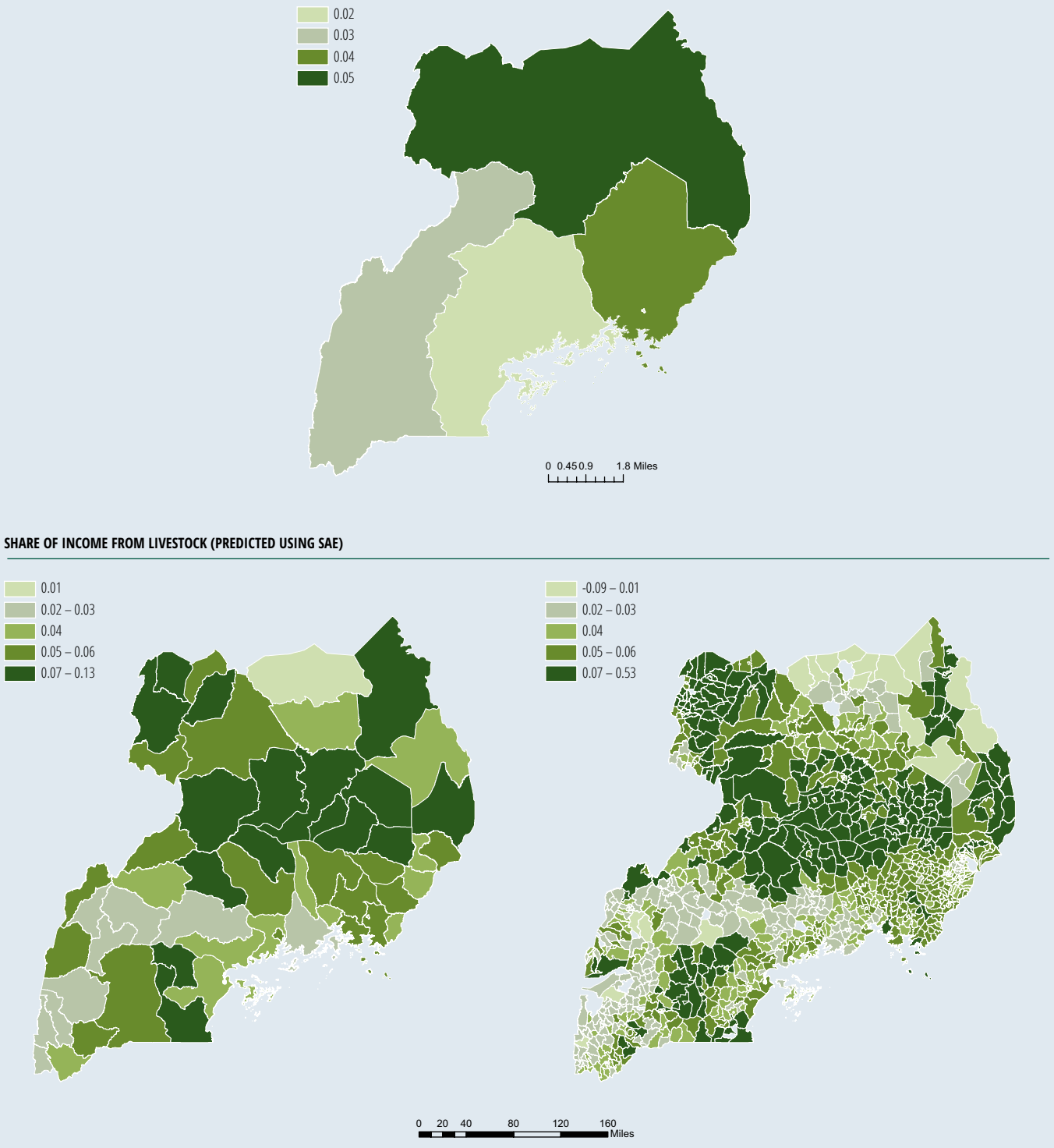
FIGURE 16. UGANDA: SHARE OF INCOME FROM LIVESTOCK ACTUAL FROM SURVEY AND PREDICTED TO CENSUS



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Finally, the analysis of the predicted income share from livestock at the sub-county level yields interesting results (Figure 16). The predicted spatial distribution looks consistent regardless of the method used, and this reinforces the argument that it is the lack of timely, reliable, and comprehensive survey and census data which are key constraints to effective policy formulation targeting local levels, more than the need for advancement in spatial methodology.

CONCLUSIONS

The integrated use of multiple data sources, such as household surveys and censuses, satellite imagery and administrative data, combined with spatial analysis techniques such as SAE and spatial allocation models, can provide reliable, coherent and location-specific insights to guide policy and investment. Cross-validation across primary and secondary data sources provides clearer insights into livestock-related farmer decision making and, in so doing, provides a better springboard for effective poverty-reduction policy action.

By fitting accurate prediction models, there is the concrete possibility of combining multi-topic household surveys with specialized databases to estimate the contribution of livestock to household livelihoods. Among the various econometric models tested, the SAE technique has been used for targeting poverty programs in many countries worldwide, and this chapter provides evidence that it could represent a potentially useful tool for informing livestock policy. Indeed, integration between different data sources allows for finer spatial resolution: regional distributions looking homogeneous based on survey data alone masks very diverse sub-county distributions emerging from the integrated use of survey and census data.

The results are internally and externally consistent with the literature, strengthening reliability. The novelty of the proposed approach is that it relies on micro-data and the census, which is particularly important for policy targeting, as it would greatly enhance the local relevance of policy interventions. In fact, there is the need to complement survey data with census information to provide more spatially-specific findings. As to external relevance and viability, this approach can be easily scaled-out to other countries with similar statistical data systems. However, it is only when a common master frame for agriculture and an integrated survey framework are established and implemented that the ultimate value of the SAE technique in providing information for evidence-based policies and investments can be fully tapped.

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3.4 COMPLEMENTING SURVEY DATA ON QUANTITY WITH QUALITATIVE INFORMATION: THE MARKET FOR ANIMAL-SOURCE FOODS IN TANZANIA AND UGANDA

KEY MESSAGES

The statistical system provides information on the quantitative dimension of the market for animal-source foods, which is one piece of the information needed to appreciate market opportunities for livestock producers.

***Ad hoc* data collection exercises are needed to appreciate the qualitative dimensions of the market for livestock products and better design livestock sector policies and investments.**

Collecting qualitative information on preferred retail forms, retail outlets and safety and quality attributes is relatively straightforward and not expensive.

Data integration is essential to provide a national level picture of the qualitative dimensions of the market for animal-source foods.

INTRODUCTION

Growing developing-country demand for livestock products potentially provides commercial opportunities for smallholder producers and the supporting service and distribution providers. Exploiting such potential requires identification and use of data on the nature of consumer demand and retail practice.

Developing countries' national statistical agencies' data on consumption, and associated dietary monitoring, capture the broad commodity level. Although they provide generally good evidence of trends in consumption and production, including quantity and value, they are insufficiently disaggregated to offer insight into consumers' preferences for quality and safety attributes. Hence, there is little guidance available to smallholder producers, to supporting distribution and service providers, or to governments supporting market-driven smallholder and food security initiatives, on the potential for local livestock product markets to deliver benefits to the producer.

National data on livestock products are often aggregated into such broad categories as 'meat' or 'meat and fish', 'dairy' and 'eggs'. Consideration of product quality and differentiation, which motivates value addition by producers and others in the value chain, is generally absent. For livestock products in developing counties, few studies of consumers' willingness to pay for specific attributes are available, although Jabbar *et al.* (2010) provides an exception. At the levels of product assembly, distribution and retailing, little beyond anecdotal information emerges. Data on product form, retail outlet type, urban and rural market differences, and characterization of consumers by income levels are little known, and this represents a barrier to the identification and service of high value markets.

This chapter presents a method for generation, synthesis and basic analysis of data to inform decisions about the retail markets for livestock products in developing countries. The results, for which an illustrative set are presented here,

"National data on livestock products are often aggregated into broad categories… Consideration of product quality and differentiation, which motivates value addition by producers and others in the value chain, is generally absent."

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generate information guide policies that might support market-led development of the livestock sector. The method is designed to be inexpensive to implement, and to provide results rapidly. It can be used to support the implementation of Pillar 2 of the CAADP.

BOX 9. CAADP PILLAR 2: MARKET ACCESS

Pillar 2 of the Comprehensive Africa Agriculture Development Programme aims at increasing market access through improved rural infrastructure and other trade-related interventions. The objectives of Pillar 2 are to: (i) accelerate growth in the agricultural sector by raising the capacities of private entrepreneurs (including commercial and smallholder farmers) to meet the increasingly complex quality and logistical requirements of markets, focusing on selected agricultural commodities that offer the potential to raise rural (on- and off-farm) incomes; (ii) create the required regulatory and policy framework that would facilitate the emergence of regional economic spaces that spur the expansion of regional trade and cross-country investments. These two objectives are best achieved when the market for agricultural products are well characterized, both from a quantitative and qualitative perspective. While quantitative information on current and projected consumption of livestock products is largely available for the African continent, there is limited information on consumers' preferred retail forms, retail outlets and safety and quality attributes, which in some circumstances could make it challenging to effectively implement Pillar 2 of the CAADP. ■

DATA

Official data available at national level

Notwithstanding their aggregate nature, household surveys and other data from official sources can be used in market analysis. They provide information on quantities consumed, price and income across expenditure categories and locations. These offer insight into which products (at an aggregate level) are growing in demand, and the extent to which demand is sensitive to price and income changes. Nationally representative consumption surveys, particularly where supplemented by price information, offer estimations of key consumer response parameters such as income and price elasticity. Although these are mostly cross-sectional in nature, a nationally representative sample generally provides sufficient variation in prices and income that inference may be drawn about consumption patterns over time, as these variables grow. Illustrative examples of use of this information are employed in this chapter for the purpose of identifying high value products, although the details of the method are not presented.

Field level data

A major challenge is the absence of quality- and income-disaggregated data at relevant points in the value chain (including the retail and consumer levels). A common approach, applied in this chapter, is the use of expert advice. In what follows, an expert informant interview is employed effectively to bridge a gap between the nationally representative aggregate data and the market level reality of assembly, distribution and retailing of products that are disaggregated across numerous forms, quality levels and consumer types. This procedure distils information on commodities into a guide on product form and retail format. Sampling procedures then address locations.

Individual observations on consumers' and retailers' characteristics, choices and practices are required for a robust analysis of products' potential for profitable smallholder delivery. Unlike farm households, with which many researchers and government agencies are familiar, such targets for survey work require interview experiences that are brief, deliver quantitative results, and do not encourage strategic responses from any market actor. Robust inference requires proper sampling and adequate sample numbers. Training of enumerators is required, both for standardized procedures and to equip them to assess selected variables that are unsuitable for survey questions.

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METHOD

Commodity selection – estimation from nationally representative survey data

From analysis of nationally representative data, livestock commodities are identified as featuring higher expenditures per unit of volume in response to increases in income. In essence, the commodities are identified for which consumers have been shown to pay higher prices as their incomes rise. For a given commodity, this approach requires the assumption that higher price is an indicator of higher quality.

The example presented here features livestock products in Uganda and Tanzania. To fully test the method, a large number of livestock commodities and products (see below for disaggregation methods) were examined. At commodity level, these included chicken, beef, goat meat, pork, milk and eggs. Applications of the method may better suit a narrower range of commodities, perhaps identified as above.

Product identification – expert informants' interviews

Meetings of expert informants were convened to generate a 'consumer product matrix' for each of the commodities identified from aggregate data. Note that a standard coding is used for each type of retail outlet. For each commodity (Table 13 is for beef), the matrix is composed of collated information on:

- The main products purchased by consumers, and their forms;
- The retail formats selling to consumers.

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TABLE 13. TANZANIA: EXAMPLE OF A CONSUMER PRODUCT MATRIX (BEEF)

	MAIN RETAIL PRODUCT FORMS
1	Bone in large piece
2	Steak, cooking, frying or roasting piece
3	Ground beef
4	Mixed beef
5	Offal

	RETAIL OUTLET TYPE
1	Abbattoir
2	Road side butcheries
3	Food markets
4	Supermarkets

To guide subsequent field work (particularly sampling and the planning of study logistics) expert informants were also called upon to list locations (both urban and rural) known to feature retail outlets selling the products identified. Similarly, for the subsequent training and informing of enumerators, the products and retail outlet types were fully described, photographed and summarized as shown in Figures A and B.

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Surveys conducted

Two surveys were conducted: one each for consumers and retailers. Consumer surveys were conducted in retail premises. Enumerators observed consumers purchasing products, and immediately following a purchase of livestock products, approached the consumer according to sampling practice (e.g. every third purchaser). Five brief questions were posed and the enumerator then observed and recorded quality of the products purchased. Retailer surveys similarly entailed a small number of brief questions and an observation on quality by the enumerator.

Sampling

Sampling draws on the expert informants' list of retail outlets locations. The sampling strategy to be pursued depends on the purpose and emphasis of the study. Sample stratification by sex of customer, rural/urban location, and type of retail outlet are all reasonable approaches. Examination of products from several commodities requires a substantial number of visits to shops, as not all shops sell all products or all commodities.

Experience in Tanzania and Uganda was that, within each of the categories of retail outlet, outlets in urban areas and outlets in rural areas were randomly selected, for a total of 36 and 42 outlets respectively. Retailers were interviewed and, in each retail outlet, a minimum of 12 consumers were randomly selected — i.e. those that were purchasing some livestock products when the enumerator was in the retail shop — and also interviewed, for a total of 144 Tanzanian and 160 Ugandan consumers.

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Identification and assessment of products' quality attributes

Information about the quality attributes that are important to developing country consumers of livestock products was drawn from the compilation of studies presented by Jabbar *et al.* (2010). Although such a list might also be compiled by expert informants, it is recommended that objective research results be used. For each commodity a list of five quality attributes was selected. An alternative is to use the expert informants to identify the quality attributes, as is reported in Jabbar *et al.* (2010) in several settings. However, a key feature of the economic analysis of product attributes is that it provides evidence of willingness to pay and hence is of more commercial relevance than opinion as regards 'what constitutes quality'. It should be noted that many of the attributes identified are, unsurprisingly, indicative of food safety and hygiene, and measurable variables such as fat content in milk, rather than of observed attributes like color and texture.

Once a set of quality attributes had been established, a scoring system for products was used which was subsequently employed to generate overall quality ratings for the products; for the retail outlets in which they were sold; and for the bundle of purchases made by consumers. Scoring is an exercise to be carried out by enumerators — not by survey respondents. The simplest form of scoring (1 and 0, or presence and absence respectively) was used and overall quality ratings were constructed by adding the scores across attributes for products, retail outlets, consumer bundles, etc. An example of quality attributes used in such scoring is presented as Table 14.

"A key feature of the economic analysis of product attributes is that it provides evidence of willingness to pay and hence is of more commercial relevance than opinion as regards 'what constitutes quality'."

TABLE 14. UGANDA: EXAMPLE OF A PRODUCTION QUALITY SCORING TABLE (MILK)

Attribute	Score = 1	Score = 0
Freshness	yes	no
Fat content	low	high
Origin/breed	Known	unknown
Cleanliness of premises/ absence of flies	Clean	unclean
Packaging	Present	absent

Characterization of consumers

The livestock product being purchased by each consumer was observed and recorded by the enumerator. Consumers were characterized by sex and income group. An income proxy was employed, requiring the assumption that the means of transport owned or used is correlated with income levels. Hence consumer surveys featured yes/no questions about such ownership and use, and results were compiled to generate income classes. For convenience, such analysis can feature 5 classes (quintiles) which are consistent with many aggregate level analyses including household surveys. Other classifications, such as upper, lower and medium (terciles) are also available. Further characterization of consumers was achieved by asking retailers to assess their customers' income class, particularly in relation to individual product forms, amounts purchased, or quality levels. All these income assessments can be used across product forms purchased, retail formats, rural/urban locations, sex of customer, quantities purchased, and statements of future intent.

Statements by consumers

Consumers were asked questions about their reasons for shopping at a particular location for the product, patterns of expenditure over time, and projections of purchases in the event of income increases (see Table 15).

FIGURE 17. DEMAND ANALYSIS: QUESTIONS TO CONSUMERS REGARDING PURCHASING BEHAVIOR

1. Why have you come to this retail outlet to buy your [product]?
(tick as many as needed)

- Known/trustworthy
- Low price
- Variety of choice
- Good quality/safety
- Close to my home
- Other (specify) _____

2. In the last year, has your household consumption of this [product] changed?
(tick one)

- A lot more
- Slightly more
- No
- Slightly less
- A lot less

3. If you had more cash to spend on livestock products, would you?

(tick as many as needed)	YES	NO
Buy more of this products	☐	☐
Buy less of this product	☐	☐
There would be no change in quantity bought	☐	☐
But this product in other retail format	☐	☐
Buy this product in other shop	☐	☐

Characterization of retailers

Enumerators recorded retail outlets' type (by code) and location, and their observations on products sold. They also assigned quality scores as described above.

FIGURE 18. DEMAND ANALYSIS: ENUMERATOR OBSERVATIONS ON RETAIL PRODUCTION (BEEF)

1. Look and rate main livestock products sold

Beef	y	n	Price / Unit	Quality scale
Bone in large piece				
Steak, cooking, frying or roasting piece				
Ground beef				
Mixed beef				
Offal				
Other (specify in cell)				

Statements by retailers

Enumerators then posed questions to retailers on assessment of customers' incomes, perceptions of market growth and potential at the product level, and constraints faced.

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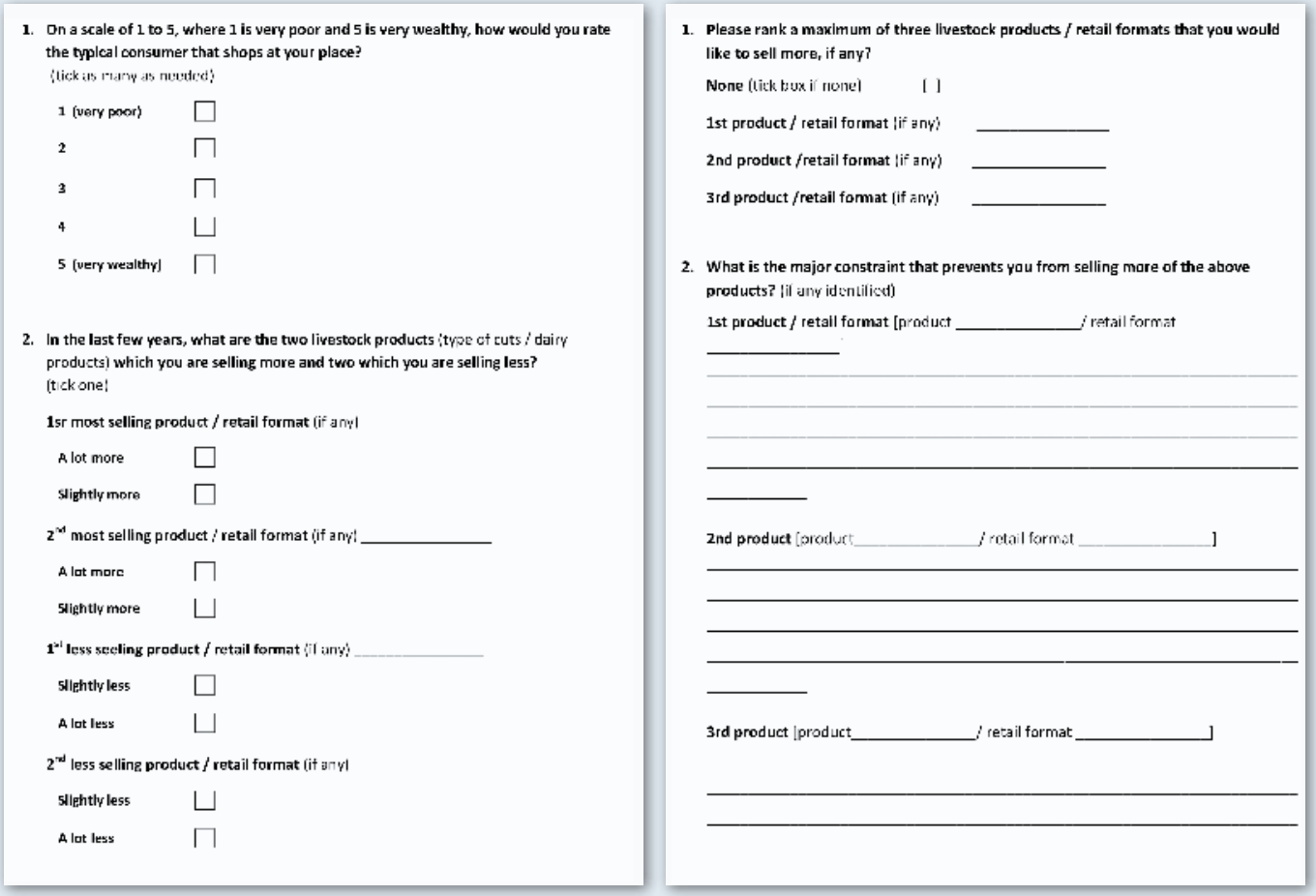
FIGURE 19. DEMAND ANALYSIS: QUESTIONS POSED TO RETAILERS



1. On a scale of 1 to 5, where 1 is very poor and 5 is very wealthy, how would you rate the typical consumer that shops at your place?
(tick as many as needed)

1 (very poor) ☐
2 ☐
3 ☐
4 ☐
5 (very wealthy) ☐

2. In the last few years, what are the two livestock products (type of cuts / dairy products) which you are selling more and two which you are selling less?
(tick one)

1sr most selling product / retail format (if any)

A lot more ☐
Slightly more ☐

2nd most selling product / retail format (if any) _____

A lot more ☐
Slightly more ☐

1st less selling product / retail format (if any) _____

Slightly less ☐
A lot less ☐

2nd less selling product / retail format (if any)

Slightly less ☐
A lot less ☐

1. Please rank a maximum of three livestock products / retail formats that you would like to sell more, if any?

None (tick box if none) [ ]

1st product / retail format (if any) _____

2nd product /retail format (if any) _____

3rd product /retail format (if any) _____

2. What is the major constraint that prevents you from selling more of the above products? (if any identified)

1st product / retail format [product _____/ retail format _____]

2nd product [product_____/ retail format _____]

3rd product [product_____/ retail format _____]

RESULTS

The studies cited as an example provided several important results:

- Across all income levels, consumers purchased approximately the same quality. This indicates that very high quality such as seen in supermarkets faces rather limited demand. This is in turn indicates that a large market exists for low and medium quality product supplied to traditional retail outlets. Smallholder producers are well-placed to deliver such products.
- Clear patterns of preference for retail outlet appeared, and these were found to be sensitive to income (Figure 20).
- Quality scores differed across products, but rural/urban differences in quality offered were not large (Figure 21).
- Consumer income was found to be a strong determinant of the product forms purchased (Figure 22).

FIGURE 20. CONSUMERS' RETAIL OUTLET PREFERENCES

FIGURE 21. QUALITY SCORED, BY RETAIL OUTLET TYPE

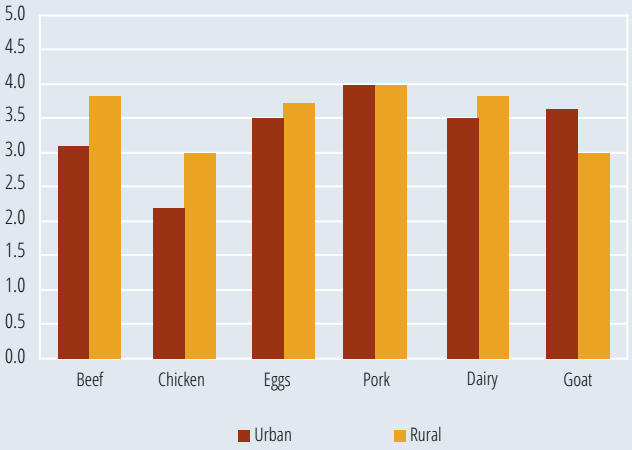
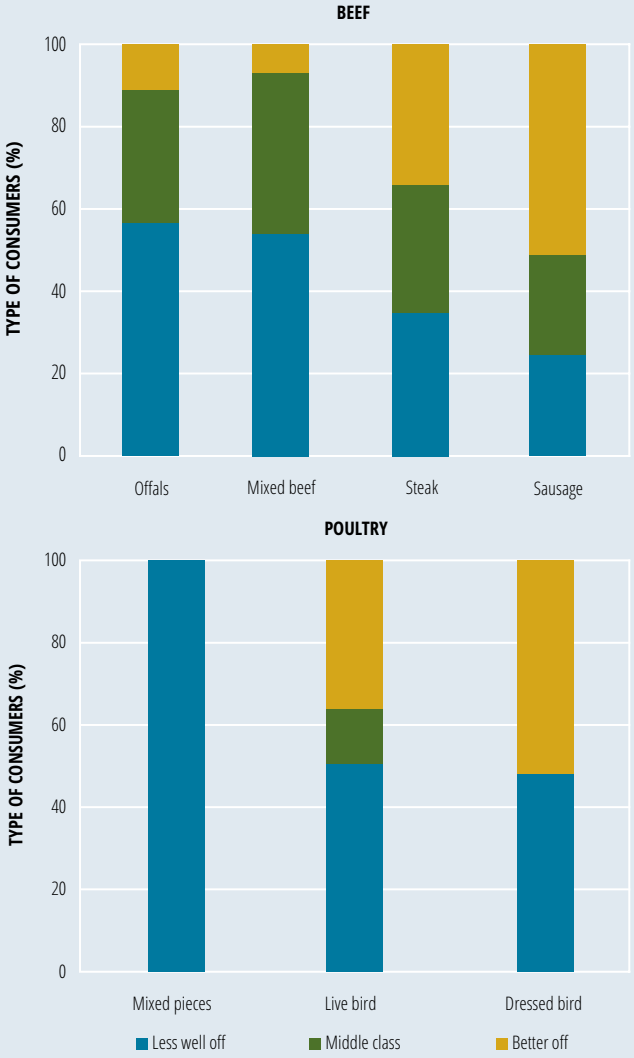


FIGURE 22. CONSUMERS' PREFERENCES FOR PRODUCT TYPE



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CONCLUSIONS

This chapter offers practitioners a method for identifying and collecting commercial information in developing country retail contexts. The method was developed to target business opportunities for smallholder livestock producers with the potential to serve vibrant retail markets. A role is identified for official data sources, particularly historical series, but the focus is on a robust procedure for private sector operators interested in investment in markets with potential growth.

The example presented proceeds from undifferentiated livestock products through to identification of shop and quality preferences for a range of consumer classes, while offering a profile of these variables for both urban and rural locations. It is notable that the method is primarily based on actual purchases and sales, rather than hypothetical statements about preferences. These are supplemented by statements by retailers and consumers about future intentions.

The examples presented here depict a range of qualities, and a generally good level of quality, of animal-sourced products on sale. Across all apparent income levels, consumers opt for a variety of quality. However, income levels do influence the choice of retail outlet and form of product consumed. These results indicate substantial opportunities for smallholder producers, and for those involved in commercial distribution to retailers.

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TABLE 15. SELECTED EXAMPLE OF RETAIL PRODUCTS

Livestock product	Retail form and description	Photograph
Beef	**Bone in Large piece** This is usually a thigh and a portion of the ribs.	
	Chops for roasting or frying These are usually small pieces of meat that are cut from the large piece and can easily be cooked without further cutting. The comprise of any part of the animal that is fleshy (e.g. ribs, muscles, bones and fats).	
	Ground beef This is usually the muscle that is minced in a machine. It may be lean or may contain some fats.	
	Offals These are the intestines and gastro enteric parts of a bovine which are edible.	

TABLE 16. UGANDA: DESCRIPTION OF RETAIL OUTLETS

Retail outlet	Description	Photograph
Abattoir	A fairly large place where animals are slaughtered and hang in large pieces.	
Roadside butchery	These are small outlets which specialize in selling meat products. The operators of such places usually purchase large pieces from abattoirs then sell smaller cuts to consumers.	
Roadside outlet	These are sheltered or unsheltered places along roads which sell food products mainly to passersby.	
Wet market	These are specialized markets which sell live animals (mainly small ruminants).	

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3.5 CONSTRAINTS: COMBINING MICRO-DATA WITH FARMERS' VIEWS

KEY MESSAGES

The statistical system provides information on the constraints affecting livestock keepers (e.g. animal diseases) but not on the root causes of the constraints (why animal diseases are rampant), which should be the target for policies and investments.

***Ad hoc* data collection is needed to identify the root causes of constraints, which depend on the main objectives for keeping animals and ultimately originate from lack or inadequate availability of land, capital, labor, and knowledge and information.**

Combining household surveys with farmers' perception of constraints is essential to identify priority areas for livestock sector policies and investments.

INTRODUCTION

Official data generated from agricultural/livestock household surveys are essential to portray the smallholder livestock production system, as chapter 3.2 illustrates, including constraints that prevent farmers from deriving full benefits from their livestock. This type of information, however, while necessary for decision makers to identify priority areas of interventions is, on its own, insufficient to guide investment decisions, for three major reasons.

First, a descriptive analysis of the household survey data helps identify some of the potential constraints on efficiency in production and sale of animals, such as animal disease. Commonly, multivariate analysis is then used in identifying some of the determinants of the constraints by exploring associations between key households' and production systems' characteristics. Such analysis, however, usually assumes a continuous range of levels of key variables, rather than a situation where access or use is constrained. Hence, policy or investment indications inevitably focus on symptomatic issues such as low productivity, rather than addressing causal mechanisms such as specific diseases or nutrition shortages.

Second, in most if not all circumstances, surveys undertaken by the national statistical authorities are based on relatively small sample sizes. The consequence is that detailed information on some features of specific livestock sub-sectors — such as on smallholder sheep fattening or dairy production systems — cannot be represented.

Third, it is widely known that policies and investments are effective when they are consistent with the goals and aspirations of the targeted beneficiaries. These are straightforward in developed countries' production systems, being few in number and generally of a commercial nature. However, in traditional production systems such as those found in developing countries, livestock play a variety of roles in the household economy and so goals and aspirations are diverse and often non-commercial. Policy and investment decisions, therefore, are more effective if based on agricultural/livestock household survey data complemented with some *ad hoc* data collection and communication with farmers that identifies both the nature of the household and the role played by livestock within it.

This chapter presents a tested method for the identification of the most important constraints faced by smallholder livestock producers which should be tackled by policies and investments. The method employs a hybrid approach to data collection, for which a tested procedure is described. Piloting of the method was carried out in Tanzania and Uganda. In Tanzania, this was achieved in partnership with the Ministry of Livestock and Fisheries Development and local authorities in four locations. In Uganda, the partnership was provided by the Ministry of Agriculture, Animal Industry and Fisheries and its extension and veterinary officers in two locations. The method could be used to support the implementation of Pillar 3 of the CAADP.

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BOX 10. CAADP PILLAR 3: FOOD SUPPLY AND HUNGER

Pillar 3 of the Comprehensive Africa Agriculture Development Programme (CAADP) aims to increase food supply and reduce hunger by raising smallholder productivity and improving responses to food emergencies. The objectives of Pillar 3 are to: (i) improve domestic production and marketing; (ii) facilitate regional trade in food staples; and (iii) build household productivity and assets. In particular, Pillar 3 is a deliberate attempt to ensure that the agricultural growth agenda targets the poor and the vulnerable directly, rather than through indirect and hoped-for trickled down effects. The implication is that investments under Pillar 3 should directly target smallholder farmers, with the objective to remove or ease constraints to their productivity. Available data, however, chiefly provides information on the symptoms of the constraints rather than on their root causes, the identification of which requires *ad hoc* data collection and stakeholder involvement. ■

EXPLORING CONTRAINTS

Increasing livestock productivity is critical to promote the development of the livestock sector, both at micro and macro level. This involves identifying and tackling the constraints which prevent farmers from deriving benefits from their animals and tapping into existing market opportunities. In the context of smallholder livestock production systems, a constraint can be defined as any barrier that prevents livestock keepers from achieving their goal of improving their livelihoods. The livestock module for multi-topic and agricultural household surveys, for example, includes questions on a list of potential constraints affecting farmer's livestock enterprise, such availability of water and feed for animals (see chapters 2.1 and 3.2). Owing to smallholders' many and diverse goals, and equally diverse ways and means of meeting them, constraint analysis also requires communication with individual smallholders and other market actors as outlined above.

Constraints occur in many different forms, and can be classified in different ways. They range from bio-physical, resource and technical constraints to those associated with socio-cultural factors, infrastructure and policy. An empirically-important attribute of constraints is that they are not easily observed, and consequently are often confused with their symptoms (e.g. 'low productivity') that are associated with performance. Performance may itself be complex to measure, as it (i) may represent satisfaction of just a few of the multiple objectives of smallholder systems, and (ii) its improvement requires easing of a number of constraints which may be sequentially associated with reduced performance (e.g. profits are a consequence of productivity, price formation, market access and value addition, amongst others). Clarification of the linkages between constraints and productivity is offered by reference to 'domains' of management (Salami *et al.*, 2010) which capture key livestock husbandry and production issues. These domains are consistent with this Sourcebook's approach to household questionnaires (see chapter 2.1).

Farmers' identification and ranking of constraints from a list of pre-identified constraints has been used by Meganathan *et al.* (2010) and Devendra (2007). In preference to pre-defined lists, Salami *et al.* (2010) opt for fundamental categories of 'long term' constraints listed as land, labor, capital, knowledge and information, access to markets, and the policy environment. This is a list recognizable to students and practitioners of economics as it includes classical factors of production and emphasizes the enabling environment that is stressed so much in recent development advocacy.

In the presence of detailed farm level data, linear programming has often been applied to identify binding constraints (Siegel and Alwang, 2005; Jansen and Wilton, 1984). As above, this approach also requires that potential constraining factors be pre-identified and appropriately incorporated into the programming. Econometric methods to estimate agricultural supply responses, using both household and country level data, have also been used to identify productivity-enhancing or hindering factors: essentially via opportunities and constraints (e.g. Heltberg and Tarp, 2002). Data envelope analysis (DEA) that combines farm efficiency analysis with statistical identification of the factors associated with low performance, has also been used as a two-step approach utilizing elements of the above methods (e.g. Gelan and Murithi 2012; Stokes *et al.*, 2007).

Few methods, however, are available that attempt to combine quantitative analyses based on household survey data with *ad hoc* data in forms that are understandable to a range of audiences and easily usable by decision makers. The method

presented in this chapter was designed according to these considerations, and to cost concerns and avoidance of complexity. It targets constraints to productivity and access to markets, building on both survey data and targeted data collection activities on a small scale.

A METHOD TO IDENTIFY CONSTRAINTS

Cost and logistic considerations require a pragmatic approach to application of available existing data, and collection of new data in ways that maximize both participatory stakeholder input and rigor in sampling and collection. In this respect, the method described here is hybrid in nature, and opportunities exist for its adaptation.

Household level survey data: demand and supply

National level household survey data on consumption are used, via estimates of elasticity, to identify products for which there is high demand or (via panel data) rapidly-growing demand. The main contribution of such analysis to an understanding of constraints is in the identification of the products to be pursued in the constraint analysis, i.e. it is expected that by removing those constraints to productivity and marketing, farmer's livelihoods will improve.

National level household survey data are also used to estimate the influence on productivity of key household and production systems' characteristics. Such analysis (typically regression) provides basic guidance on identification of constraints to productivity, but has limitations as outlined above. A further problem with household level survey data is that, in many countries, survey observations on rural households that feature relevant production systems are both few in number and difficult to identify because sampling does not usually address individual systems or constraint sets.

Ad hoc data collection

Targeted *ad hoc* data collection is thus recommended to better appreciate constraints to productivity and market access, which requires that, beyond analyzing nationally representative household surveys data, producers themselves nominate and assign importance to the constraints they face. This can be achieved in two ways (group discussion and individual surveys) which are used in combination here.

- Contributions of the group approach include the establishment of shared understanding, and development of ownership of the data generation and analysis process. Use of 'management domains' (animal health, feeding, breeding and markets) allows both convenience in packaging constraints and critical mass amongst producer participants. Four management domains were employed to generate both discussion and individual data on the symptoms (again, following Salami *et al.* (2010) and consistent with Sourcebook methods of household data collection):
  - Animal feeds
  - Animal breeding
  - Animal health
  - Markets and inputs
- Group activities surrounding constraint analysis offers an opportunity for explanation and examination of the difference between a 'stated' (or symptomatic) constraint and an 'underlying' (basic, or long term) constraint. Many

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participants harbor individual concerns, and indeed hopes for specific forms of assistance, that are expressed as 'stated' constraints such as low milk yield or large numbers of deaths amongst young animals. The method developed here collects such information, but also insists on its assignment to underlying causes (such lack of animal feed at certain times of the year). 'Underlying' constraints are few in number, and are readily comparable across sites and commodity systems.

- Individual household data generated by interviews offers statistical inference. Importantly, producers' individual responses may be classified according to factors (e.g. enterprise size and specialization, locality, market served) that may be hypothesized to influence both identification of constraints and the severity of their influence. Household interviews characterize each producer's production systems, and assembled data in relation to five 'underlying' or basic constraints as identified by Salami *et al.* (2010):
  - Land
  - Labor
  - Capital
  - Information and knowledge
  - Other (infrastructure, policies, institutions, markets)
- Individual data collection also presents the opportunity to identify individual households' objectives or purposes in keeping livestock, better to interpret the impact of constraints.

IMPLEMENTATION

The above method was implemented in both Uganda and Tanzania, where a sample of 35 farmers took part to the exercise, assisted by 5–7 research and support staff. In particular, pursuant to objectives of the analysis, questionnaires were prepared for the guidance of discussion groups and individual data collection. Identification of commodities can be either purposive (e.g. for those with an interest in a commodity) or a consequence of study design (e.g. for those with an interest in commodities with characteristics that need defining as part of the study). The pilot of the method which is reported here fell into the latter category, with interest directed at constraints to producers of commodities for which demand is high and/or rapidly growing.

Household survey data analysis

Identification of commodities with such characteristics can draw on an analysis of the National Panel Survey data. This used consumption and expenditure data to identify the livestock commodities featuring increasing expenditures per unit of volume in response to increases in income. Hence, commodities are identified for which consumers pay higher prices as incomes rise. This approach maintains the assumption that commodity price is an indicator of quality. The pilots also used the results of the demand analysis described in chapter 3.4 of this Sourcebook, and aggregate national data on patterns of consumption. These analyses allowed identification of pork and dairy in Uganda, and dairy in Tanzania, as commodity sectors offering substantial opportunities to smallholder producers.

Sampling

A group of 30–50 producers are selected from a locality of interest. Primarily, such interest is centered on localities known to feature poverty amongst small-scale livestock producers. Participants should be representative of critical social, economic and geographic distributions.

The sample size enables critical levels of degrees of statistical freedom. Randomness can be achieved by compilation of a list of all farm households and ordered selection. Additional guidelines (such as prohibiting multiple participants from singe households) can be imposed, and experience in Uganda and Tanzania encourages this. Key sample strata include administrative zones, type of farm production system, degree of engagement in marketing and trading of inputs and livestock products, gender, age, and ownership of local and/or improved breeds. Stratified sampling is to be superimposed on the randomization procedures, and in practice in Tanzania and Uganda this was achieved by way of information shared by local extension authorities.

Ad hoc data collection

The day's activities are laid out in a single questionnaire/guidelines document. The sequence is shown in Figure 22. The questionnaire/guideline document is displayed continuously during the sessions.

- A principle facilitator conducts all sessions, except round-robin 'cafes' and focus group domain sessions.

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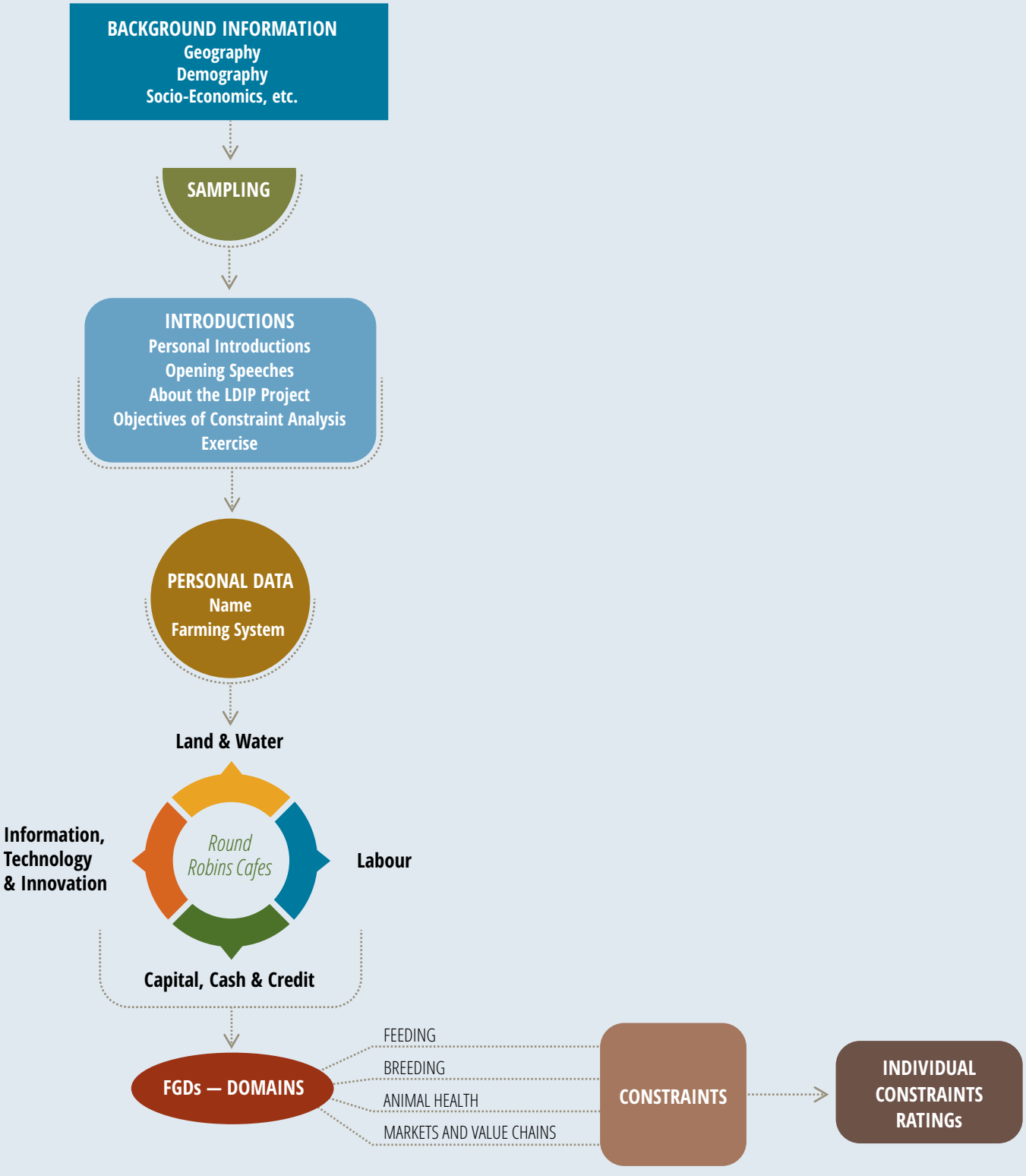
FIGURE 23. FLOW CHART REPRESENTATION OF CONSTRAINT ANALYSIS METHODOLOGY



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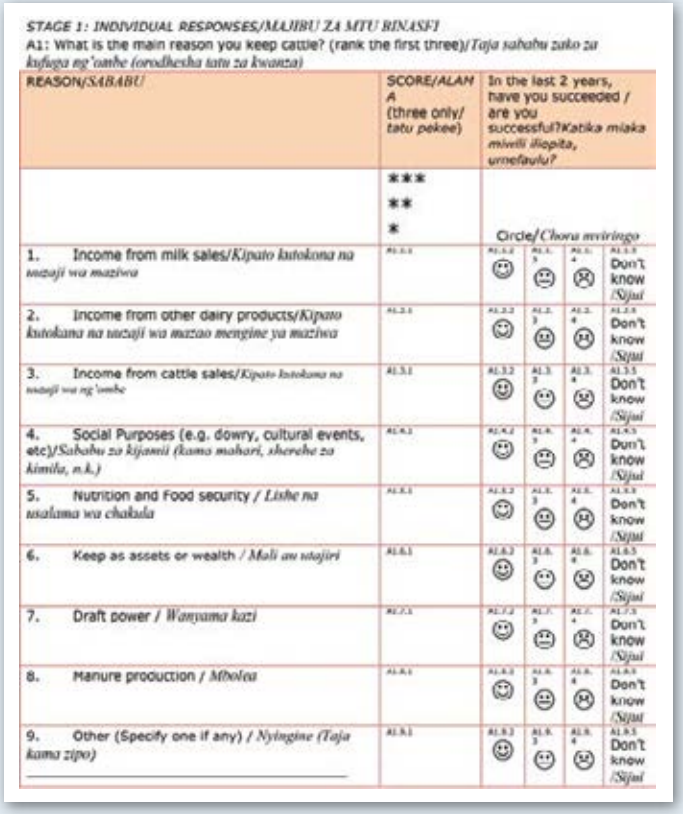
- The participants attend all sessions, except the domain focus group discussions (see below).
- The 'introductions', 'personal data' and 'farming systems' sessions are conducted in a plenary style. The round robin 'cafes' require separation (generally random, but see below) into four groups, each one involving a 'café' basic constraint topic (land, labor, capital, knowledge and information).
- At the end of the round robin cafes, all participants will have completed all basic constraint sessions and completed these sections of the questionnaire.
- Following departure of the participants at the end of each day, an informal team meeting is held, chaired by the principal facilitator. This addresses and assesses key quality control variables and provides for discussion of the day. This also assists in adjustments to procedures for the following days' work.

Introductory sessions

The plenary introductions session features both participatory and individual sections. Basic information on size and nature of production systems is interspersed with derivation of local knowledge (see excerpts in Figure 24). A key (individual) component is the identification and rankings of 'main reason' for keeping the animal species in question: this provides much context for the examination of constraints. The milk marketing question in Figure 24 is an example of assessment of individual conditions: specifically the presence of quality incentives.

FIGURE 24. CONSTRAINT ANALYSIS: ELICITATION OF LOCAL KNOWLEDGE

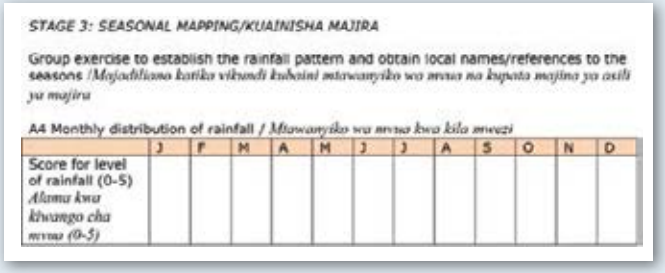


STAGE 1: INDIVIDUAL RESPONSES/MAJIBU ZA MTU BINAFSI

A1: What is the main reason you keep cattle? (rank the first three)/*Taja sababu zako za kufuga ng'ombe (orodhesha tatu za kwanza)*

REASON/*SABABU*	SCORE/*ALAMA* (three only/ *tatu pekee*)	In the last 2 years, have you succeeded / are you successful?/*Katika miaka miwili iliopita, umefaulu?*
	*** ** *	Circle/*Chora mviringo*
1. Income from milk sales/*Kipato kutokana na mauzo ya maziwa*		Don't know /*Sijui*
2. Income from other dairy products/*Kipato kutokana na mauzo ya mazao mengine ya maziwa*		Don't know /*Sijui*
3. Income from cattle sales/*Kipato kutokana na mauzo ya ng'ombe*		Don't know /*Sijui*
4. Social Purposes (e.g. dowry, cultural events, etc)/*Sababu za kijamii (kama mahari, sherehe za kimila, n.k.)*		Don't know /*Sijui*
5. Nutrition and Food security / *Lishe na usalama wa chakula*		Don't know /*Sijui*
6. Keep as assets or wealth / *Mali au utajiri*		Don't know /*Sijui*
7. Draft power / *Wanyama kazi*		Don't know /*Sijui*
8. Manure production / *Mbolea*		Don't know /*Sijui*
9. Other (Specify one if any) / *Nyingine (Taja kama zipo)* _____		Don't know /*Sijui*

Identification of main reasons for keeping livestock species (cattle, Tanzania)



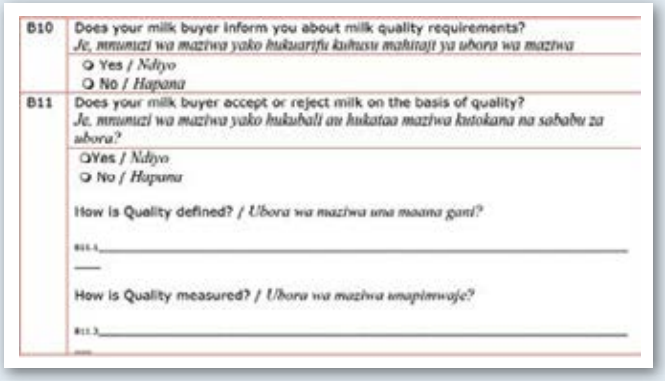
STAGE 3: SEASONAL MAPPING/KUAINISHA MAJIRA

Group exercise to establish the rainfall pattern and obtain local names/references to the seasons /*Majadiliano katika vikundi kubaini mtawanyiko wa mvua na kupata majina ya asili ya majira*

A4 Monthly distribution of rainfall / *Mtawanyiko wa mvua kwa kila mwezi*

	J	F	M	A	M	J	J	A	S	O	N	D
Score for level of rainfall (0-5) *Alama kwa kiwango cha mvua (0-5)*												

Group discussion of rainfall pattern



B10 Does your milk buyer inform you about milk quality requirements?
Je, mnunuzi wa maziwa yako hukuarifu kuhusu mahitaji ya ubora wa maziwa
❍ Yes / *Ndiyo*
❍ No / *Hapana*

B11 Does your milk buyer accept or reject milk on the basis of quality?
Je, mnunuzi wa maziwa yako hukubali au hukataa maziwa kutokana na sababu za ubora?
❍ Yes / *Ndiyo*
❍ No / *Hapana*

How is Quality defined? / *Ubora wa maziwa una maana gani?*

How is Quality measured? / *Ubora wa maziwa unapimwaje?*

Individual questions on milk marketing and quality premia (cattle, Tanzania)

Round robin cafes

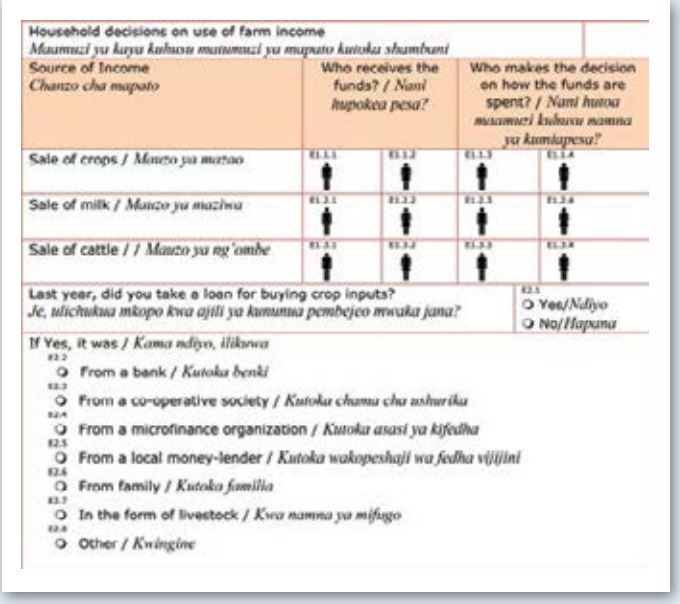
Round robin cafes (addressing land and water, labor, capital and information and knowledge) are individual data collection exercises, each of which focuses on a basic or underlying constraint. Questions address both the quantification of resources such as land and water (see example in Figure 25's top left panel) and examination of how the resources are used (Figure 25's right panel examines intra-household labor allocation). Other examples in Figure 25 include the gender distribution of income from various sources and the use of credit.

FIGURE 25. CONSTRAINT ANALYSIS: IDENTIFICATION OF UNDERLYING CONSTRAINTS

C3 Are you concerned about having access to land for the next 2 years for:
Je, unahofia kuhusu upatikanaji wa ardhi katika miaka miwili ijayo kwa ajili ya:

	Food and cash crop production / *Uzalishaji wa chakula na mazao ya biashara*	Fodder production / *Uzalishaji wa mimea lishe kwa mifugo*	Grazing / *Kuchunga*
Owned / *Inayomilikiwa*	C1.1.1 ○ Yes / *Ndiyo* ○ No / *Hapana*	C1.1.2 ○ Yes / *Ndiyo* ○ No / *Hapana*	C1.1.3 ○ Yes / *Ndiyo* ○ No / *Hapana*
Rented / *Inayokodishwa*	C1.2.1 ○ Yes / *Ndiyo* ○ No / *Hapana*	C1.2.2 ○ Yes / *Ndiyo* ○ No / *Hapana*	C1.2.3 ○ Yes / *Ndiyo* ○ No / *Hapana*
Family / *Ya familia*	C1.3.1 ○ Yes / *Ndiyo* ○ No / *Hapana*	C1.3.2 ○ Yes / *Ndiyo* ○ No / *Hapana*	C1.3.3 ○ Yes / *Ndiyo* ○ No / *Hapana*
Communal / *Ya jamii*	C1.4.1 ○ Yes / *Ndiyo* ○ No / *Hapana*	C1.4.2 ○ Yes / *Ndiyo* ○ No / *Hapana*	C1.4.3 ○ Yes / *Ndiyo* ○ No / *Hapana*
Other / *Nyingine*	C1.5.1 ○ Yes / *Ndiyo* ○ No / *Hapana*	C1.5.2 ○ Yes / *Ndiyo* ○ No / *Hapana*	C1.5.3 ○ Yes / *Ndiyo* ○ No / *Hapana*

Individual questions on land access
(cattle, Tanzania)



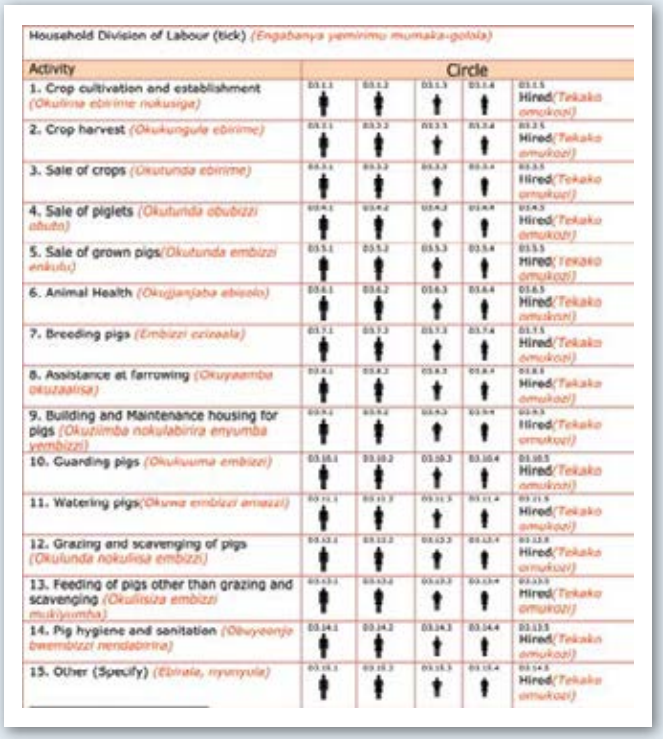
Household decisions on use of farm income
Maamuzi ya kaya kuhusu matumizi ya mapato kutoka shambani

Source of Income / *Chanzo cha mapato*	Who receives the funds? / *Nani hupokea pesa?*		Who makes the decision on how the funds are spent? / *Nani hutoa maamuzi kuhusu namna ya kuzitapesa?*	
Sale of crops / *Mauzo ya mazao*	E1.1.1	E1.1.2	E1.1.3	E1.1.4
Sale of milk / *Mauzo ya maziwa*	E1.2.1	E1.2.2	E1.2.3	E1.2.4
Sale of cattle / / *Mauzo ya ng'ombe*	E1.3.1	E1.3.2	E1.3.3	E1.3.4

Last year, did you take a loan for buying crop inputs? E2.1
Je, ulichukua mkopo kwa ajili ya kununua pembejeo mwaka jana?
○ Yes/*Ndiyo* ○ No/*Hapana*

If Yes, it was / *Kama ndiyo, ilikuwa*
E2.2 ○ From a bank / *Kutoka benki*
E2.3 ○ From a co-operative society / *Kutoka chama cha ushirika*
E2.4 ○ From a microfinance organization / *Kutoka asasi ya kifedha*
E2.5 ○ From a local money-lender / *Kutoka wakopeshaji wa fedha vijijini*
E2.6 ○ From family / *Kutoka familia*
E2.7 ○ In the form of livestock / *Kwa namna ya mifugo*
E2.8 ○ Other / *Kwingine*

Individual questions on receipt and control of income, and on use of credit
(cattle, Tanzania)



Household Division of Labour (tick) *(Engabanya yemirimu mumaka-golola)*

Activity	Circle				
1. Crop cultivation and establishment *(Okulima ebirime nokusiga)*	D3.1.1	D3.1.2	D3.1.3	D3.1.4	D3.1.5 Hired *(Tekako omukozi)*
2. Crop harvest *(Okukungula ebirime)*	D3.2.1	D3.2.2	D3.2.3	D3.2.4	D3.2.5 Hired *(Tekako omukozi)*
3. Sale of crops *(Okutunda ebirime)*	D3.3.1	D3.3.2	D3.3.3	D3.3.4	D3.3.5 Hired *(Tekako omukozi)*
4. Sale of piglets *(Okutunda obubizzi obuto)*	D3.4.1	D3.4.2	D3.4.3	D3.4.4	D3.4.5 Hired *(Tekako omukozi)*
5. Sale of grown pigs *(Okutunda embizzi enkulu)*	D3.5.1	D3.5.2	D3.5.3	D3.5.4	D3.5.5 Hired *(Tekako omukozi)*
6. Animal Health *(Okujjanjaba ebisolo)*	D3.6.1	D3.6.2	D3.6.3	D3.6.4	D3.6.5 Hired *(Tekako omukozi)*
7. Breeding pigs *(Embizzi ezizaala)*	D3.7.1	D3.7.2	D3.7.3	D3.7.4	D3.7.5 Hired *(Tekako omukozi)*
8. Assistance at farrowing *(Okuyaamba okuzaalisa)*	D3.8.1	D3.8.2	D3.8.3	D3.8.4	D3.8.5 Hired *(Tekako omukozi)*
9. Building and Maintenance housing for pigs *(Okuzimba nokulabirira enyumba yembizzi)*	D3.9.1	D3.9.2	D3.9.3	D3.9.4	D3.9.5 Hired *(Tekako omukozi)*
10. Guarding pigs *(Okukuuma embizzi)*	D3.10.1	D3.10.2	D3.10.3	D3.10.4	D3.10.5 Hired *(Tekako omukozi)*
11. Watering pigs *(Okuwa embizzi amazzi)*	D3.11.1	D3.11.2	D3.11.3	D3.11.4	D3.11.5 Hired *(Tekako omukozi)*
12. Grazing and scavenging of pigs *(Okulunda nokulisa embizzi)*	D3.12.1	D3.12.2	D3.12.3	D3.12.4	D3.12.5 Hired *(Tekako omukozi)*
13. Feeding of pigs other than grazing and scavenging *(Okulisiza embizzi mukijumba)*	D3.13.1	D3.13.2	D3.13.3	D3.13.4	D3.13.5 Hired *(Tekako omukozi)*
14. Pig hygiene and sanitation *(Obuyeeonjo bwembizzi nendabirira)*	D3.14.1	D3.14.2	D3.14.3	D3.14.4	D3.14.5 Hired *(Tekako omukozi)*
15. Other (Specify) *(Ebirala, nyonyola)*	D3.15.1	D3.15.2	D3.15.3	D3.15.4	D3.15.5 Hired *(Tekako omukozi)*

Individual questions on household labor use, and gender allocation of tasks
(pigs, Uganda)

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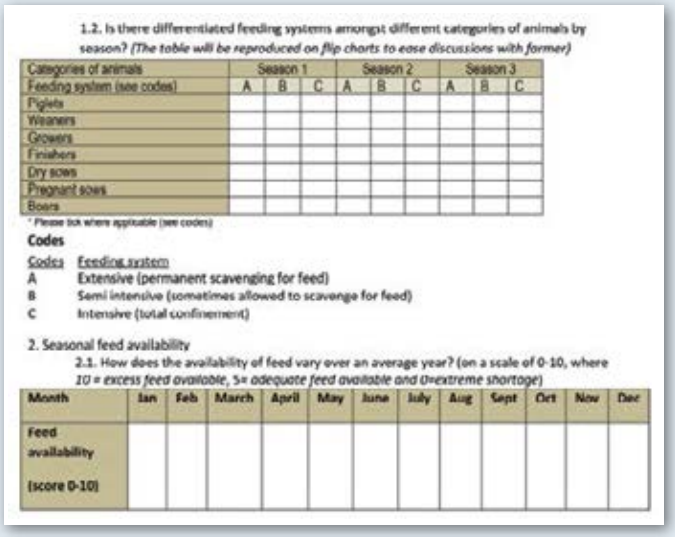
Domain sessions

Domain sessions provide the opportunity for groups to define key constraints. The management domains (feeds, breeding, animal health and markets and inputs) provide a focus for discussion of constraints, and the use of self-selected groups encourages the concentration of expertise in the appropriate domain. Each participant appears in just one domain discussion, at which constraints (limited to four from each domain session) relevant to that domain are nominated and described according to their underlying basic constraint (land, labor, capital, knowledge and information, as well as 'other'). Prior to the specification of constraints, domain sessions first compile sets of information about the production and marketing system that inform later analysis of the individually-collected data. Examples in Figure 26 include identification of feed sources and systems, seasonal feed availability (left panel) and basic epidemiological information (right panel).

FIGURE 26. CONSTRAINT ANALYSIS: EXCERPTS FROM DOMAIN SESSION CHECKLISTS



1.2. Is there differentiated feeding systems amongst different categories of animals by season? *(The table will be reproduced on flip charts to ease discussions with farmer)*

Categories of animals	Season 1			Season 2			Season 3		
Feeding system (see codes)	A	B	C	A	B	C	A	B	C
Piglets									
Weaners									
Growers									
Finishers									
Dry sows									
Pregnant sows									
Boars									

* Please tick where applicable (see codes)

Codes

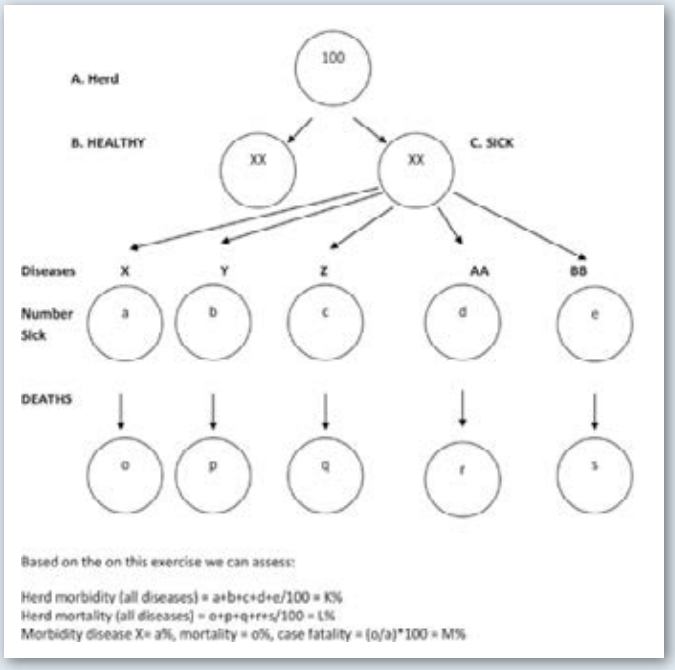
Codes	Feeding system
A	Extensive (permanent scavenging for feed)
B	Semi intensive (sometimes allowed to scavenge for feed)
C	Intensive (total confinement)

2. Seasonal feed availability

2.1. How does the availability of feed vary over an average year? (on a scale of 0-10, where *10 = excess feed available, 5= adequate feed available and 0=extreme shortage)*

Month	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Feed availability (score 0-10)												

Excerpt from "Feeds" domain session checklist (pigs, Uganda)



Excerpt from "Animal Health" domain session checklist (cattle, Tanzania)

Individual rating of constraints

In the final plenary session, a representative of each domain session's focus group discussion summarizes the group's work and presents and explains the selection of constraints and their attribution to basic constraints. At the conclusion of these presentations, each participant is asked to do two things with the A4 page (see example, Figure 19) listing the identified constraints:

- Indicate his/her main purpose of keeping the livestock species in question (available from his/her response to the main questionnaire);
- Rank, on the A4 page, the three most important constraint/basic constraint combinations (by circling a cell on the table on the A4 sheet).

TABLE 17. EXAMPLE LIST OF NOMINATED CONSTRAINTS (MILK, WAKISO DISTRICT, UGANDA).

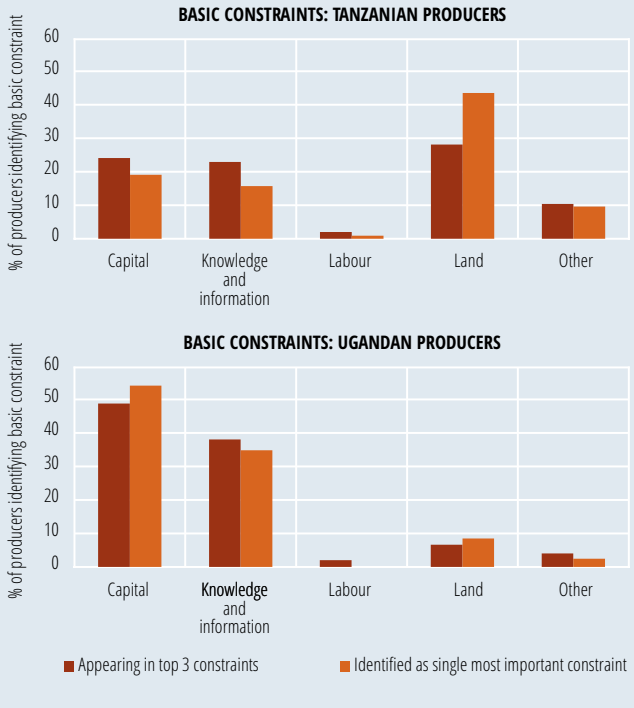
	CONSTRAINT	SCORE	LAND	LABOUR	CAPITAL	KNOWLEDGE & INFORMATION	OTHER
MARK-INP	Lack of access to high quality cows		■		■	■	
MARK-INP	Lack of access to loans for expansion and increased productivity				■		
MARK-INP	Slow growth of group action/co-operatives				■	■	
MARK-INP	Lack of good technical help and service					■	
ANBREED	Lack of knowledge in use and mixing of feeds, making silage					■	
ANBREED	Poor quality and high cost of concentrated feeds				■	■	
ANBREED	Lack of appropriate feed processing machines			■	■		
ANBREED	Inadequate feed quantity (esp. in dry season)		■	■			
ANHEALTH	High cost of drugs				■	■	
ANHEALTH	Low level of husbandry		■			■	■
ANHEALTH	Poor veterinary services					■	■
ANHEALTH	Ineffective drugs				■	■	■
FEED	Lack of available replacement animals				■	■	
FEED	Inefficient AI services (delivery and information)			■		■	
FEED	Limited breeding-related information					■	
FEED	Lack of communication with farmers for feedback and learning					■	■

RESULTS

Key results delivered from Tanzania and Uganda depict first, the substantial difference in basic constraint identification between the two countries (Figure 27). Land dominates the lists of constraints in Tanzania, while capital and knowledge do so in Uganda.

- Producers nominated a range of ('stated') constraints in both countries (see Figure 28 for Tanzania). A notable feature of the results is that the nominated constraints dwell on resources (e.g. land, seasonal feed fluctuations, water). Land tenure (a policy consideration) is also identified by many Tanzanian participants. In both Tanzania and Uganda, notable results included a general reluctance to nominate animal health as a constraint, and the small proportion of participants nominating soft infrastructure such as market information and extension services.

FIGURE 27. BASIC CONSTRAINTS IDENTIFIED IN TANZANIA AND UGANDA



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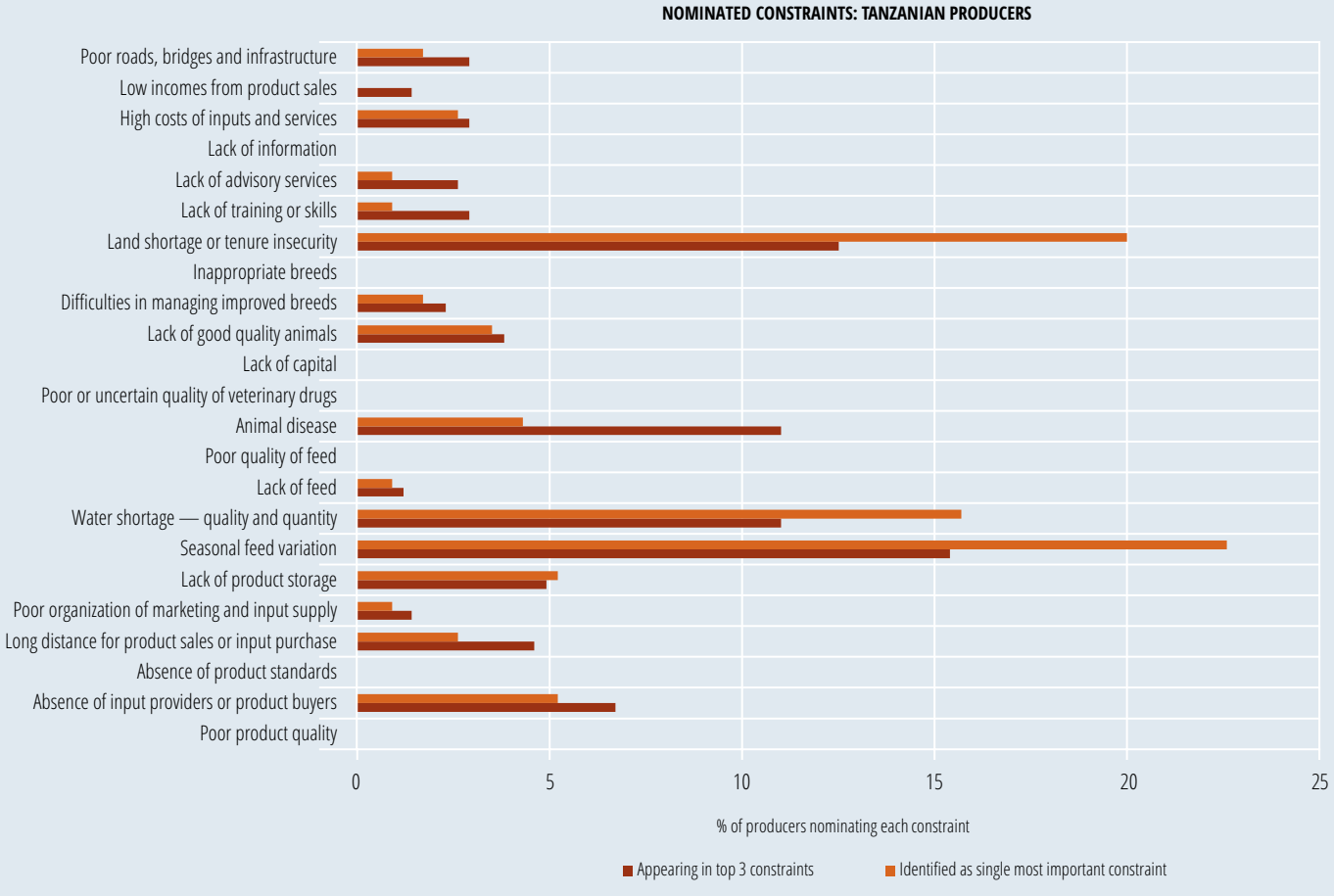
- In both Uganda and Tanzania, cross-tabulation of producers' nominated constraints with the other information generated revealed:
  - Locality is a strong determinant of constraints identified;
  - Little evidence of linkages between main reasons for keeping the animals and the constraints identified;
  - Stage of development of a household's production and marketing system was a strong determinant of constraints identified;
  - The type of knowledge and skills that producers' saw as lacking were strongly related to the constraints they faced.

FIGURE 28. TANZANIA: CONSTRAINTS NOMINATED BY PRODUCERS



CONCLUSIONS

This chapter puts forth a method for the identification, prioritization and explanation of the constraints faced by smallholder livestock producers. The results of pilot studies conducted in Tanzania (for dairy) and Uganda (for pigs and dairy) are presented as examples, with a discussion of analysis and use. The method employs a hybrid, opportunistic approach to data collection, and is designed to overcome several limitations of existing methods for constraint analysis. Chief among these methodological advances is the demarcation between basic or underlying constraints, and nominated constraints which are symptomatic of the basic constraints. The method also allows for compilation of both forms of constraint.

The method is applicable across commodity sectors, and several potential approaches to selection of commodity are identified. The pilot studies targeted high-growth livestock sectors, and so used a demand-related commodity selection mechanism. An improvement offered by the method is that individual households' intentions or purposes of keeping a species is fully recorded, and used in the definition and interpretation of constraints.

The results obtained offer some important messages to agencies interested in the easing of constraints faced by smallholder livestock producers. First, smallholders' basic constraints are closely linked to resources (land and water, but also capital) and the extent to which this applies is dependent on locality. Second, little evidence suggests that smallholders' objectives influence their definition of constraints. Hence, interventions to ease constraints should target localities and production systems rather than management categories. However, a third result is that constraints (both nominated and basic) identified are closely related to the stage of development of the household with regard to size, productivity and market utilization.

The constraint 'knowledge and information' occupied a surprisingly high ranking amongst basic and nominated constraints in both pilot countries. The form taken by the constraint was able to be linked both to commodity sector and to stages of development of household production and marketing. This provides substantial insight into research and extension needs for smallholder-oriented development.

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RECOMMENDATIONS

Dialogue and interaction with livestock policy makers and stakeholders in Africa have resulted in the following recommendations which, if promptly implemented, would be the first steps in improving livestock data systems in Africa.

To National Governments:

1. Ensure dialogue between the Bureau of Statistics with other data stakeholders to integrate livestock data into the National Statistical Plan, which would include design, financing and implementation of surveys with the aim of generating adequate information on the sector.

2. Provide for the adequate inclusion of livestock in the integrated survey framework as recommended by the *Global Strategy to Improve Agricultural and Rural Statistics*. This will guarantee that the different survey instruments jointly generate comprehensive and timely information on livestock, provided that adequate financial resources are allocated for the implementation of the various surveys.

3. Adopt agreed-upon international standards and classifications for the collection of livestock data and the generation of livestock statistics so as to ensure the generation of accurate statistics at country, regional and continental level. This harmonization should be discussed and agreed upon at the sub-regional level.

4. Include animal health- and disease-related data among the core data on agriculture identified by the *Global Strategy to Improve Agricultural and Rural Statistics*.

5. Update on a regular basis livestock technical conversion factors and reproductive parameters, the estimation of which is critical to generate accurate livestock statistics, including livestock population, production levels and livestock value added.

6. Improve the quality of administrative record livestock data, which are key for the Ministry responsible for animal resources to deliver public goods.

7. Include livestock in Living Standards Measurement Surveys, which is essential to appreciate how livestock contribute to household livelihoods.

8. Implement, at regular intervals, different types of specialized livestock surveys as recommended under the integrated survey framework of the *Global Strategy to Improve Agricultural and Rural Statistics*. The objective of these surveys address priority areas for investment to increase livestock production and productivity. These surveys could target herd composition and dynamics, feed availabilities, breeding, meat, milk and manure production or other specific issues.

9. Commit to undertaking ad hoc surveys through the Ministry responsible for Livestock to generate critical livestock information when considering alternative policies and investments.

10. Ensure that livestock is adequately represented in a national data platform for the dissemination of agricultural data and statistics, and in so doing enable easy access to national and sub-regional survey results and other relevant data.

To Regional, Pan-African Institutions and the International Community:

1. Encourage national governments to include animal health and disease-related data among the core data on agriculture identified by the *Global Strategy*.

2. Facilitate the adoption of common methodologies to estimate technical conversion factors, so as to allow cross-country comparison of livestock data.

3. Create a common data platform at the regional and pan-African level to follow and leverage the trends and dynamics of the livestock sector.

4. Develop methodologies to improve the quantity and quality of available livestock data, both from a statistical and institutional perspective.

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5. Facilitate the sharing of best practices in survey design and implementation among African countries in order to adequately include livestock in the integrated survey framework recommended by the *Global Strategy to Improve Agricultural and Rural Statistics*.

6. Provide financial and technical assistance to countries to undertake ad hoc surveys to generate to generate critical livestock information when considering alternative policies and investments.

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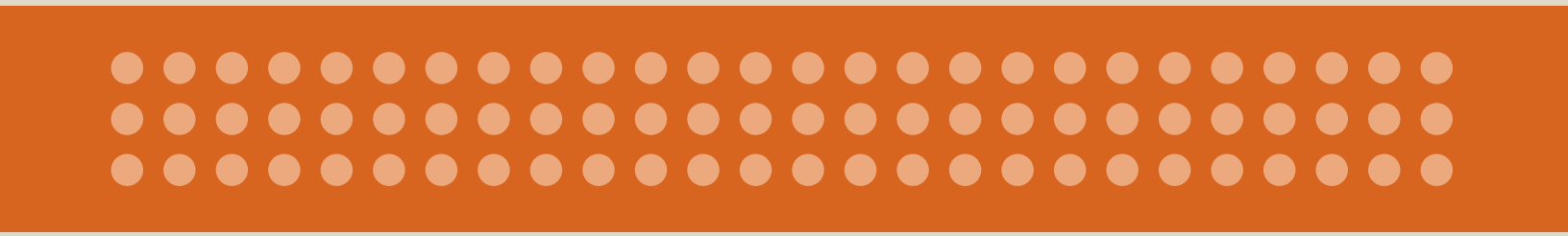

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Livestock
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Investing in the Livestock Sector: Why Good Numbers Matter **is a sourcebook for decision makers on how to improve livestock data. Funded by the Gates Foundation, it is the output of a joint collaborative initiative, drawing together the World Bank, the FAO, ILRI, AU-IBAR and the national governments of Uganda, Tanzania and Niger.**

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