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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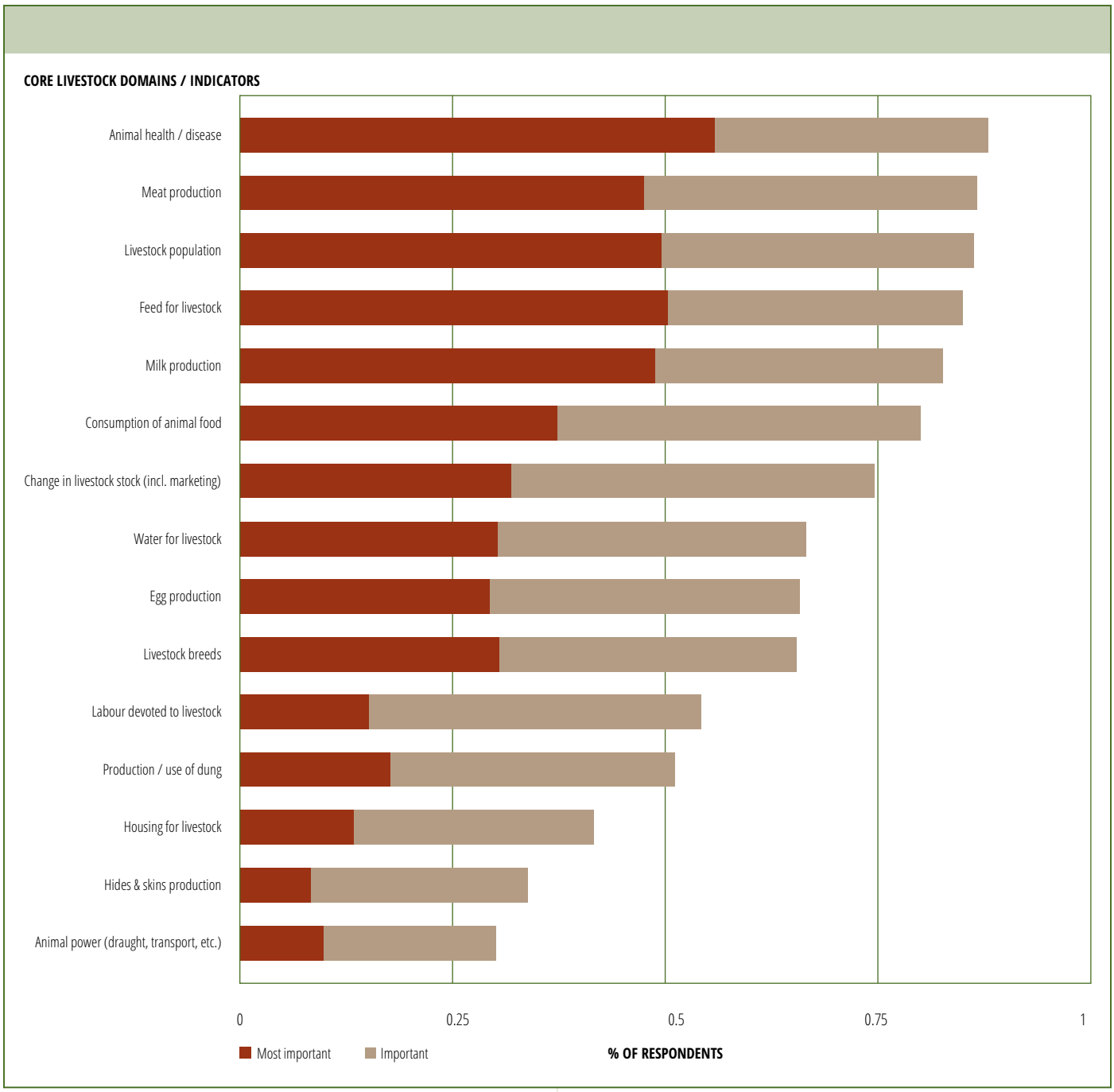

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AGRICULTURAL AND LIVESTOCK CENSUSES AND SURVEYS IN WEST AFRICA

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

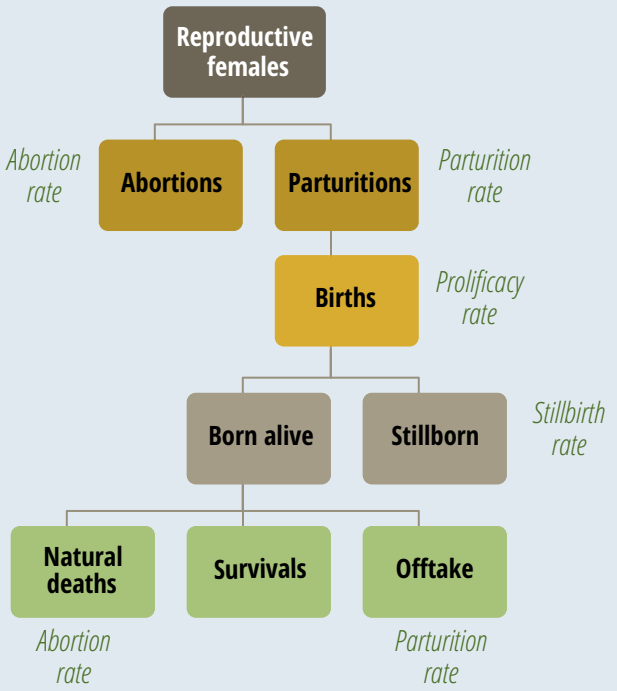
The Government of Burkina Faso undertook the General Census of Agriculture between 2006 and 2010. The previous one was administered in 1993. The Census aimed to fully measure agriculture; generate a sampling frame for subsequent agricultural surveys; and favor the establishment of a permanent agricultural 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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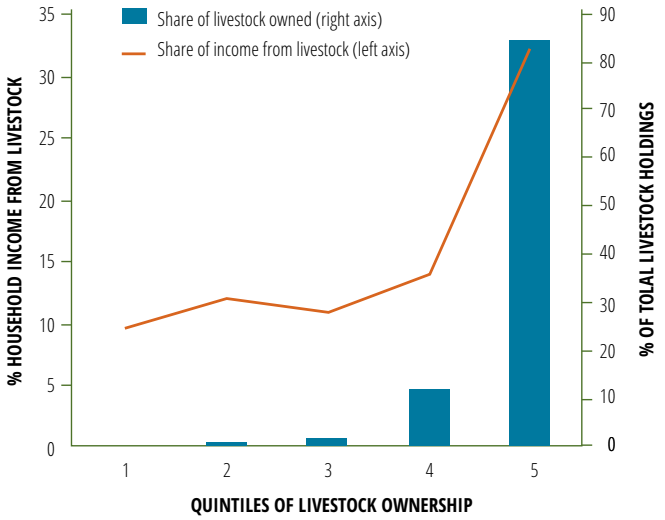
BOX 8. LIVESTOCK AND LIVELIHOODS IN TANZANIA

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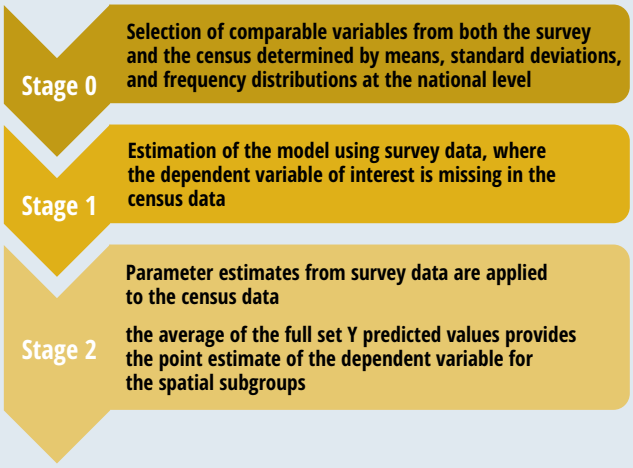
"Through the integration of survey and census data, decision makers could benefit from the detailed information in the survey and the large sample size of the census to analyze variables at a higher spatial disaggregation than would be possible with the survey alone."

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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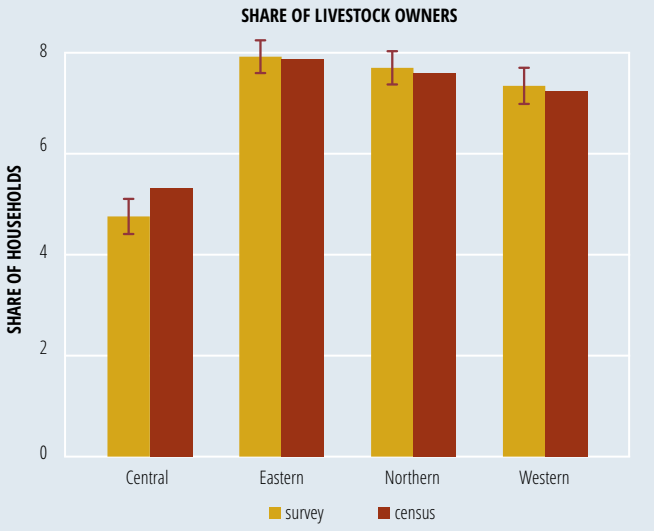
The predictors used include: land size (separately by agricultural, pasture, and other land); number of livestock heads by type (disaggregated by indigenous and exotic bulls, cows and calves, poultry, small ruminants); average weekly egg and milk production; age and gender of the household head; the 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

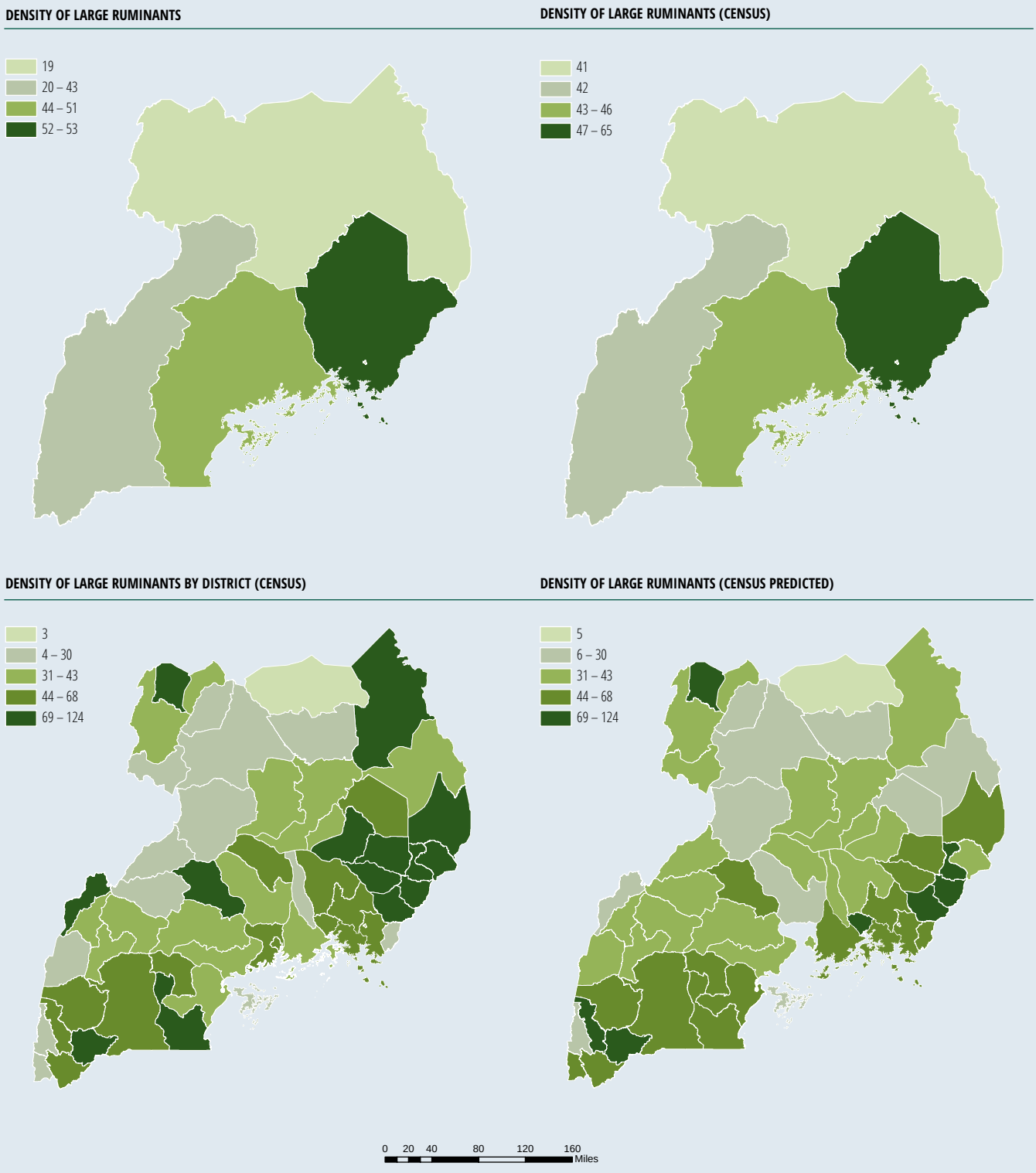

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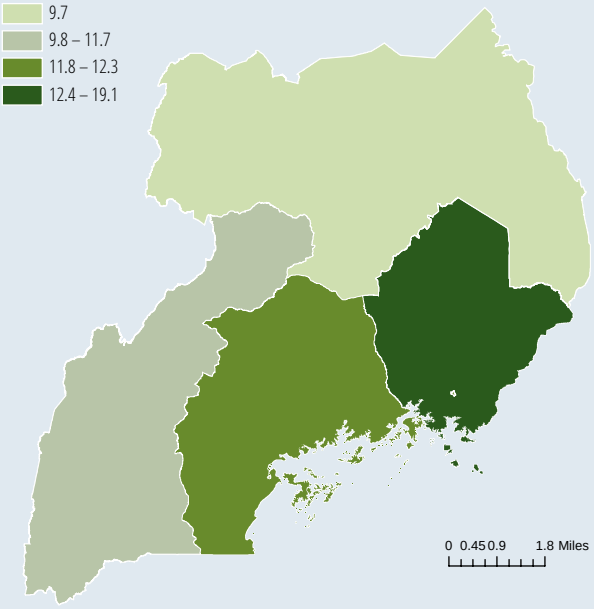
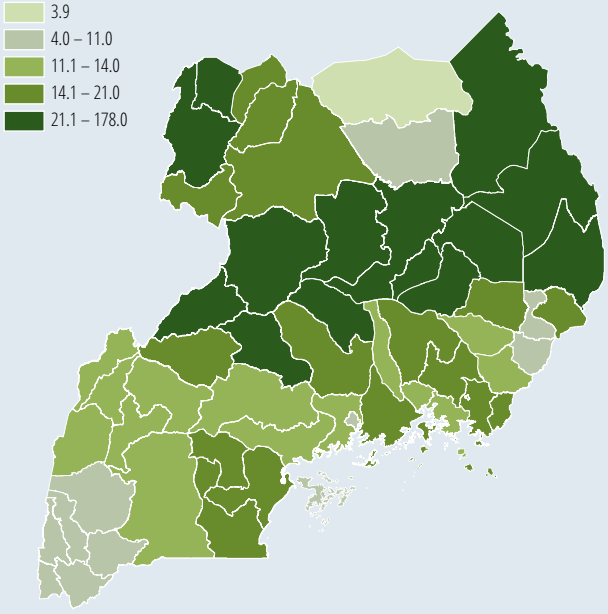
FIGURE 15. UGANDA: PER CAPITA LIVESTOCK INCOME ACTUAL FROM SURVEY AND PREDICTED TO CENSUS

PER-CAPITA LIVESTOCK INCOME PPP (ACTUAL)

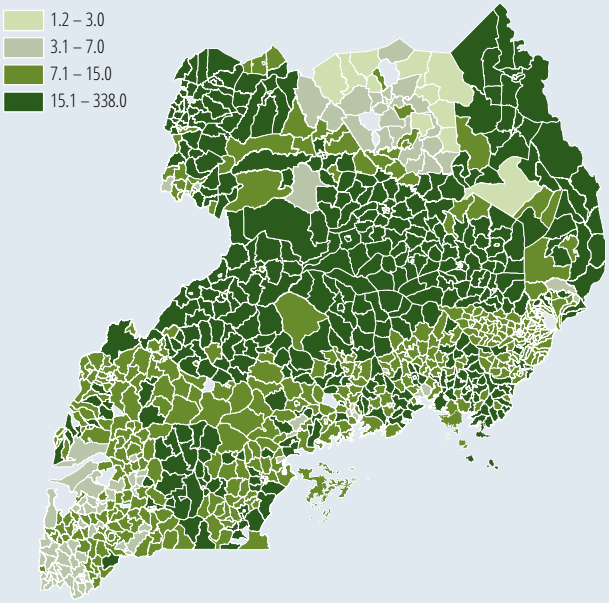


PER-CAPITA LIVESTOCK INCOME (PREDICTED USING SAE)

CENSUS (DISTRICT)



CENSUS (SUB-COUNTY)



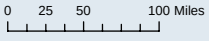


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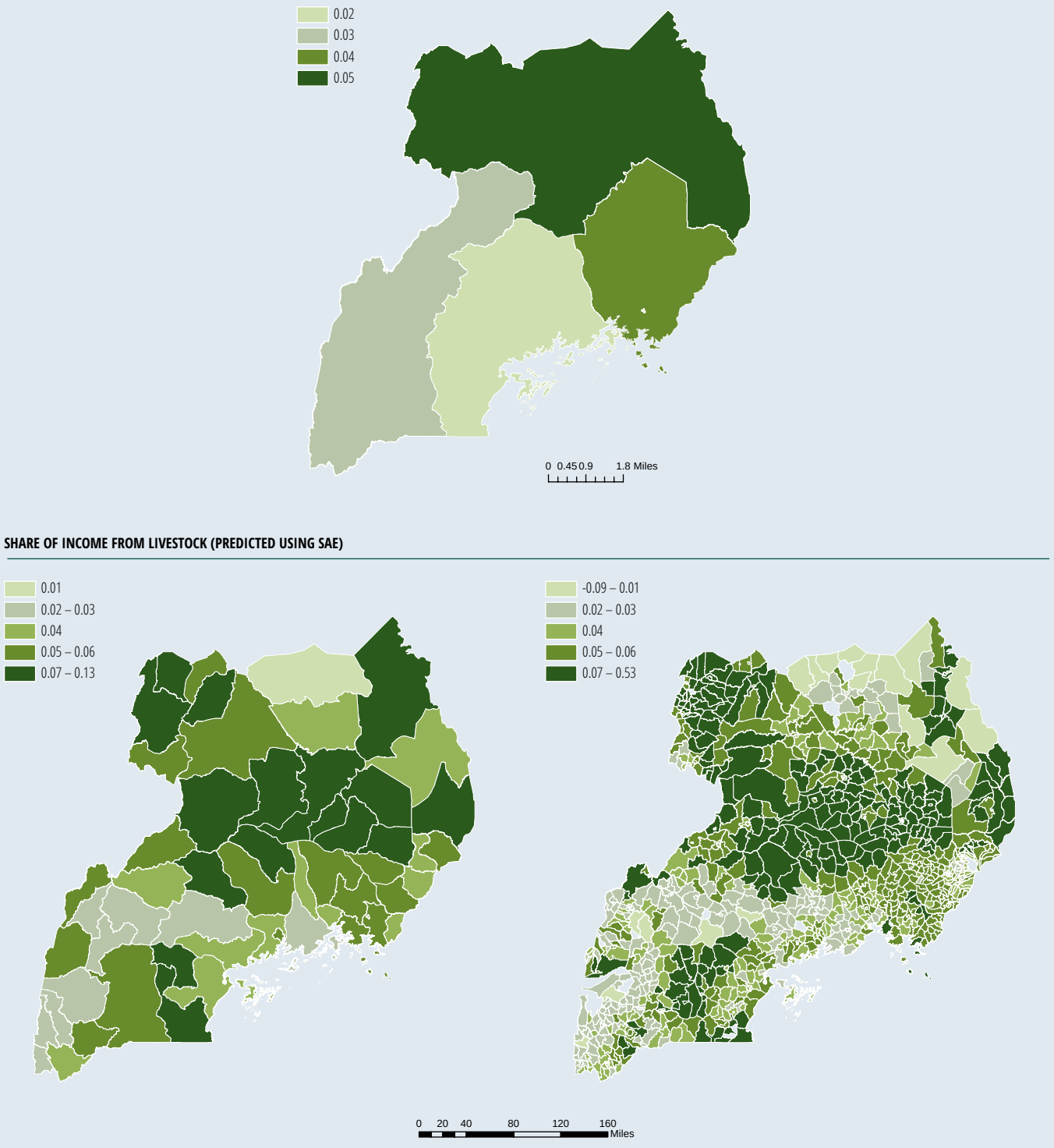
FIGURE 16. UGANDA: SHARE OF INCOME FROM LIVESTOCK ACTUAL FROM SURVEY AND PREDICTED TO CENSUS



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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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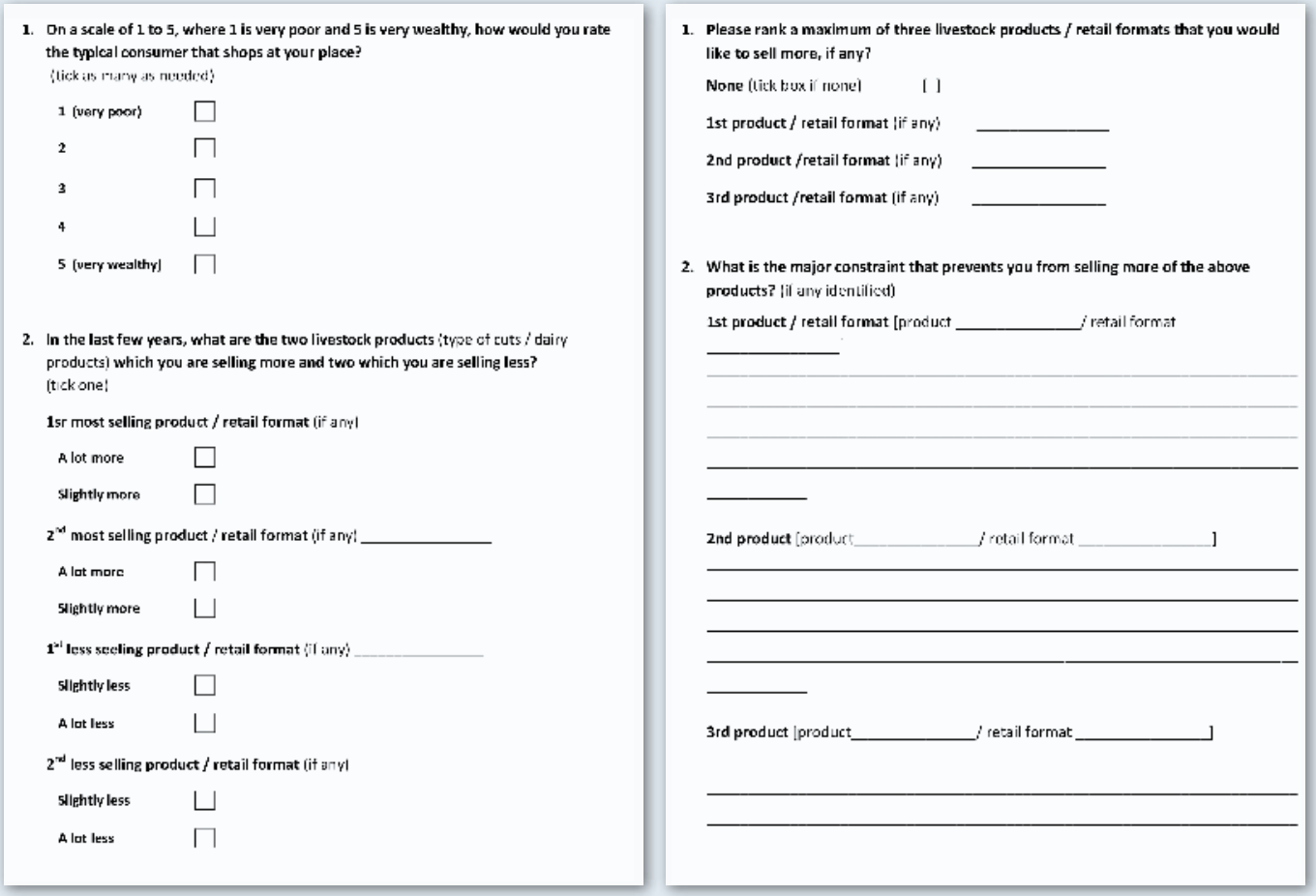
FIGURE 19. DEMAND ANALYSIS: QUESTIONS POSED TO RETAILERS



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

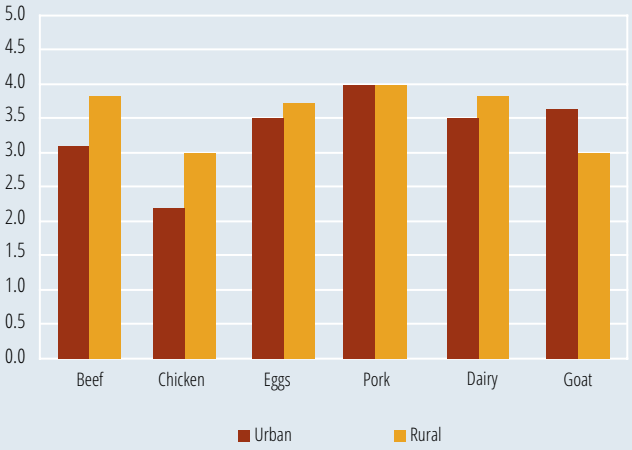
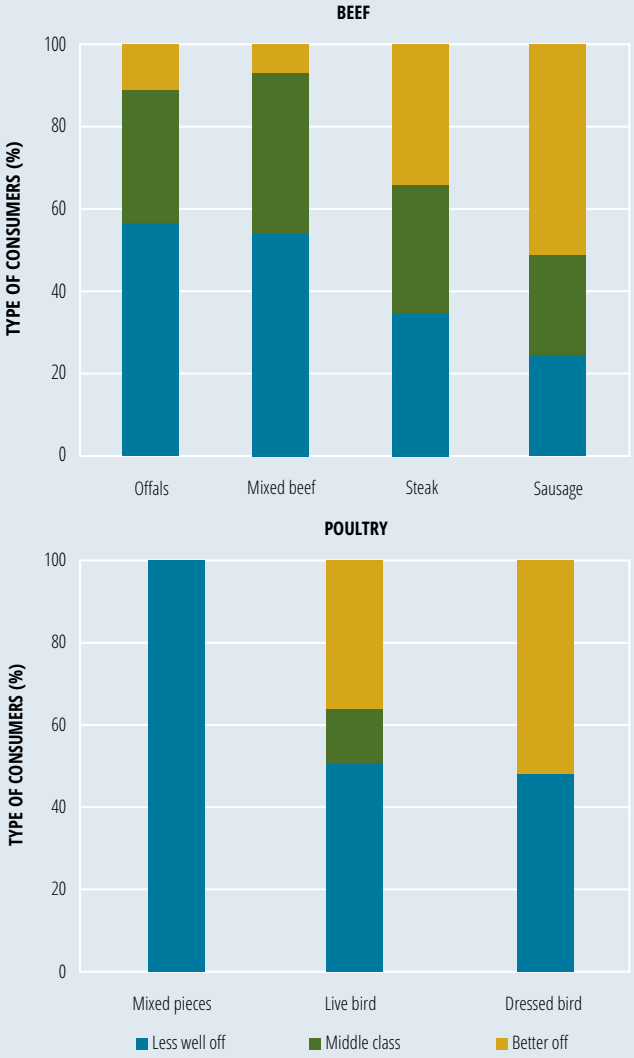


FIGURE 22. CONSUMERS' PREFERENCES FOR PRODUCT TYPE



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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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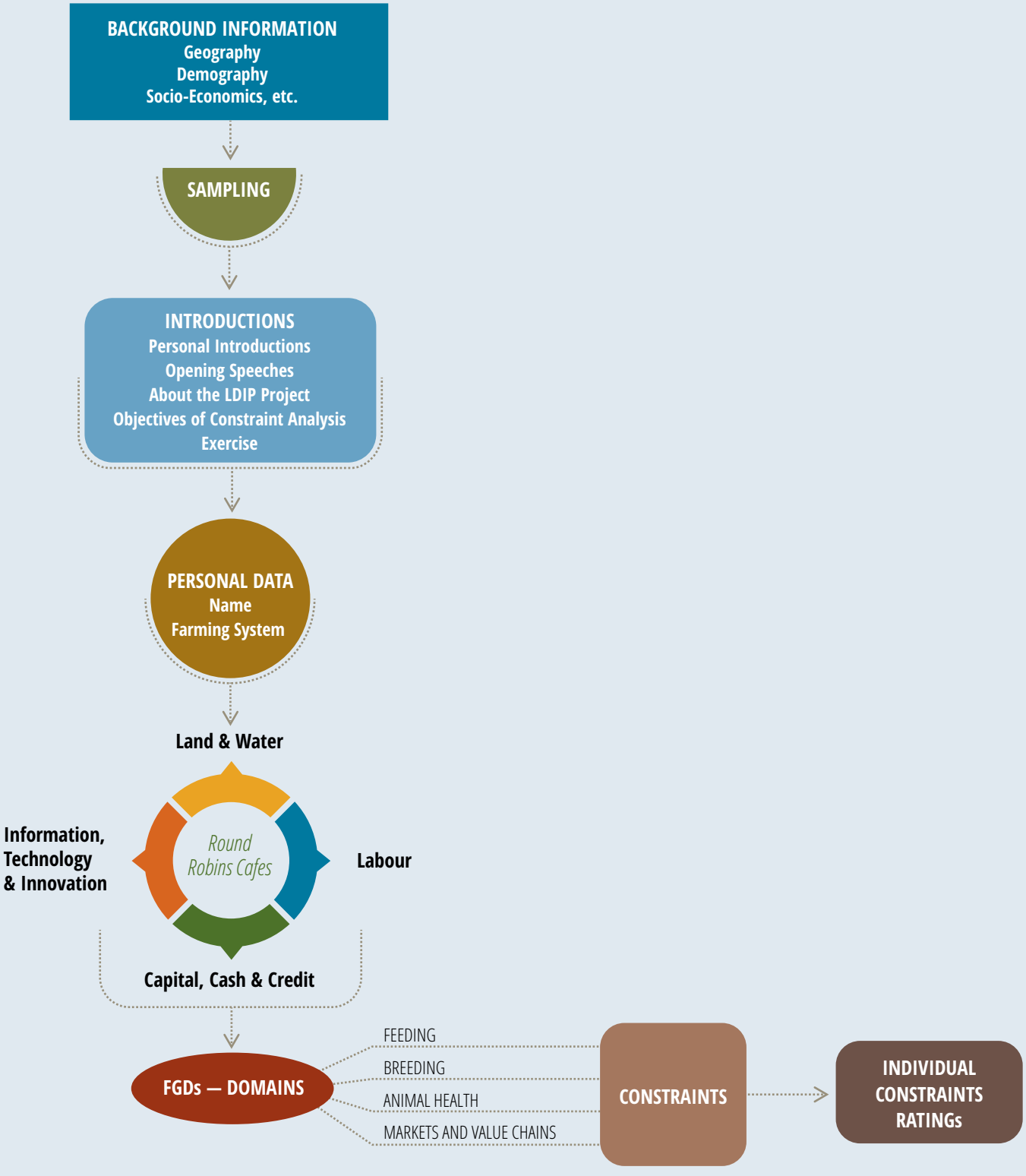
FIGURE 23. FLOW CHART REPRESENTATION OF CONSTRAINT ANALYSIS METHODOLOGY



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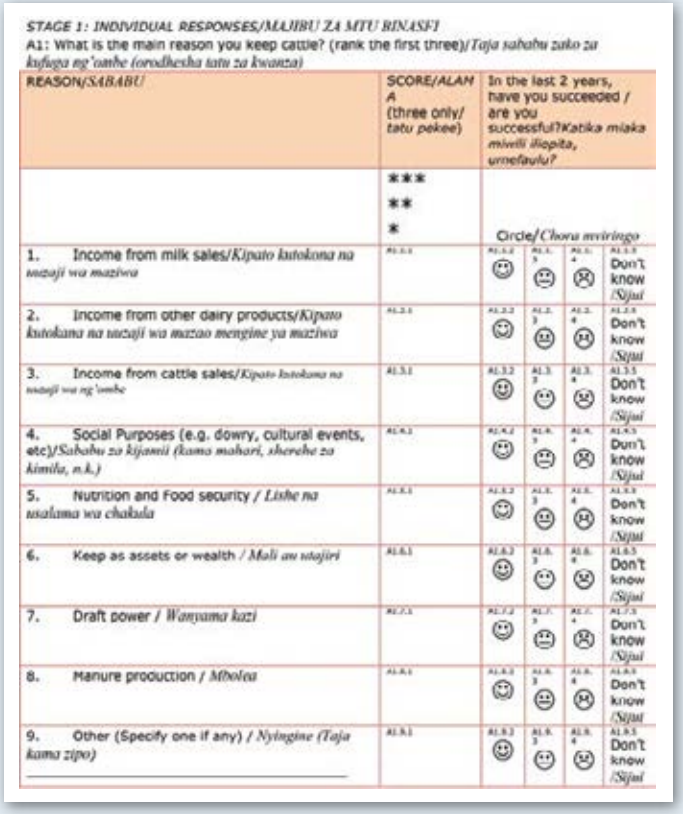
- The participants attend all sessions, except the domain focus group discussions (see below).
- The 'introductions', 'personal data' and 'farming systems' sessions are conducted in a plenary style. The round robin 'cafes' require separation (generally random, but see below) into four groups, each one 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

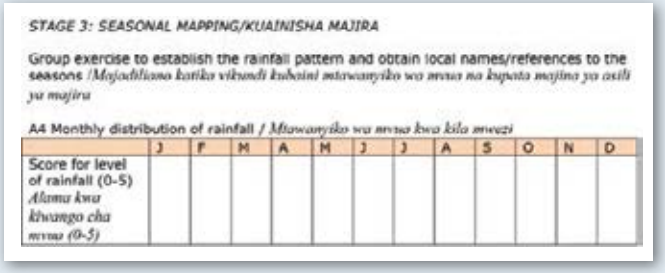


STAGE 1: INDIVIDUAL RESPONSES/MAJIBU ZA MTU BINAFSI

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)



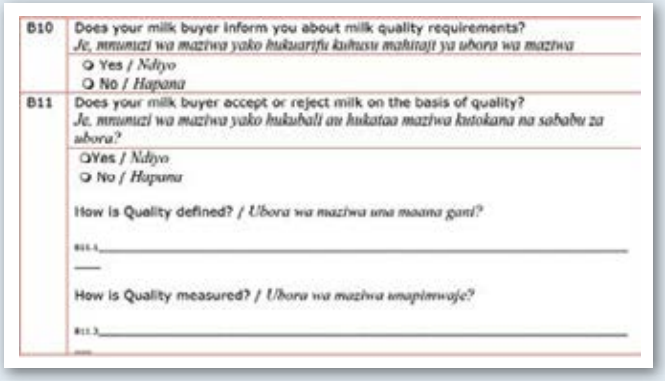
STAGE 3: SEASONAL MAPPING/KUAINISHA MAJIRA

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

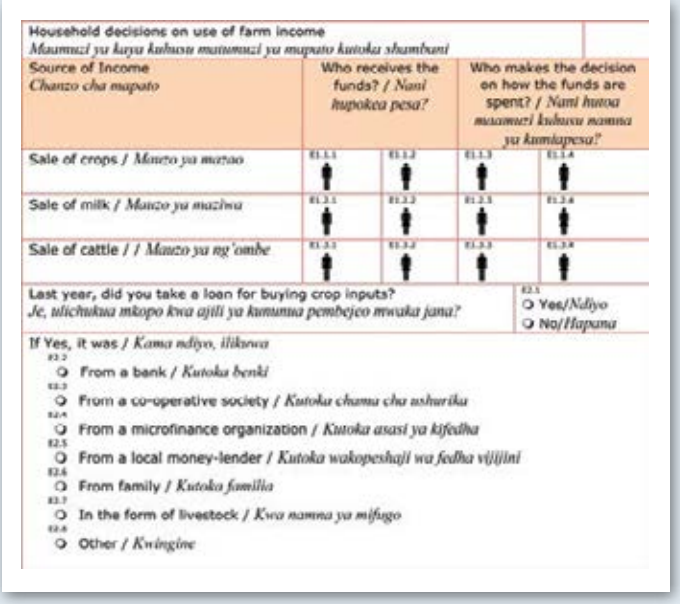
Round robin cafes (addressing land and water, labor, capital and information and knowledge) are individual data collection exercises, each of which focuses on a basic or underlying constraint. Questions address both the quantification of resources such as land and water (see example in Figure 25's top 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)



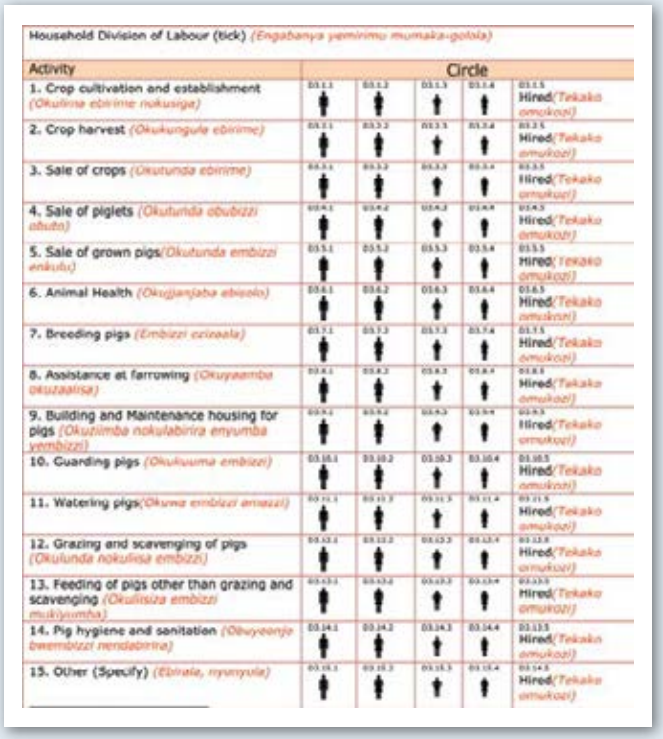
Household decisions on use of farm income
Maamuzi ya kaya kuhusu matumizi ya mapato kutoka shambani

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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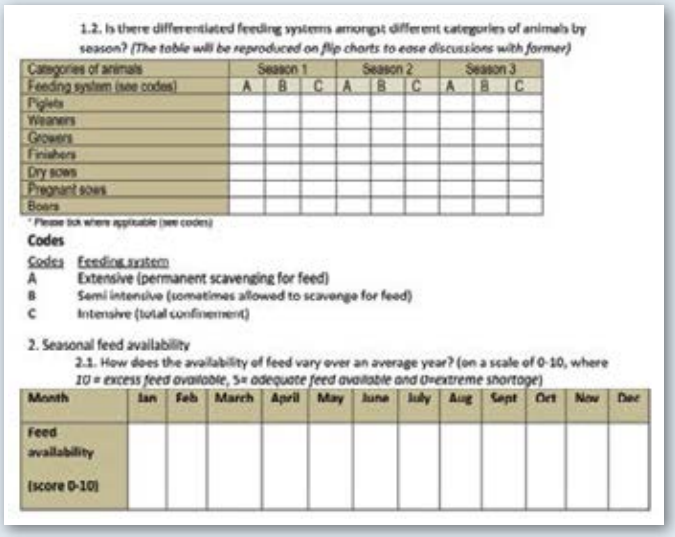
Domain sessions

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

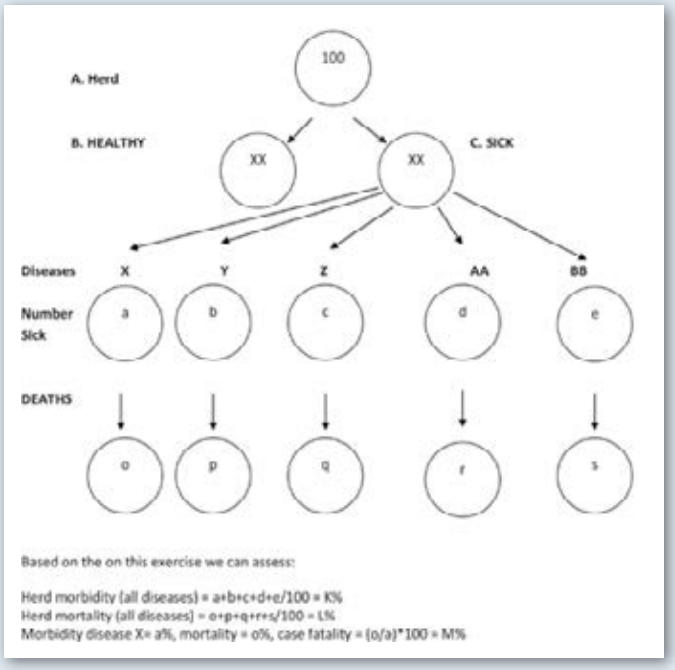
Codes	Feeding system
A	Extensive (permanent scavenging for feed)
B	Semi intensive (sometimes allowed to scavenge for feed)
C	Intensive (total confinement)

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).

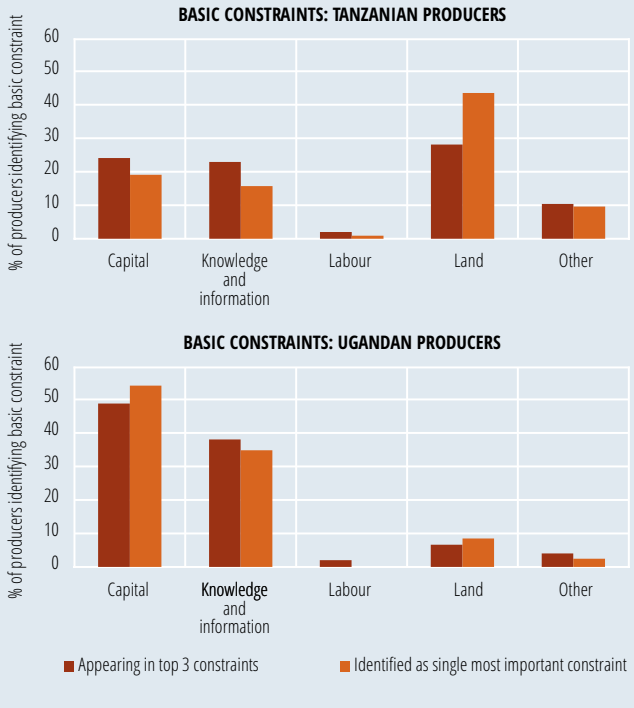
	CONSTRAINT	SCORE	LAND	LABOUR	CAPITAL	KNOWLEDGE & INFORMATION	OTHER
MARK-INP	Lack of access to high quality cows		■		■	■	
MARK-INP	Lack of access to loans for expansion and increased productivity				■		
MARK-INP	Slow growth of group action/co-operatives				■	■	
MARK-INP	Lack of good technical help and 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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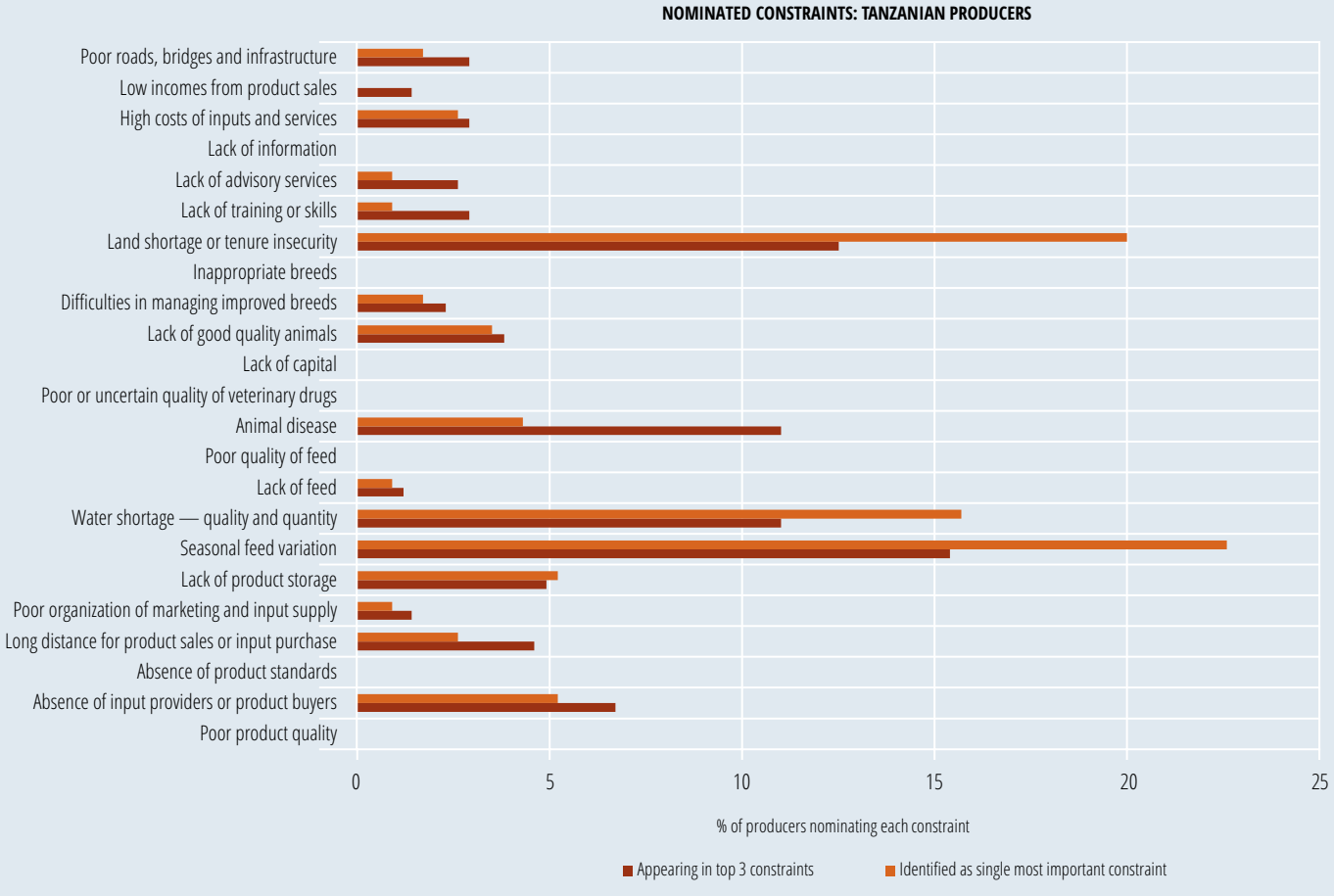
- In both Uganda and Tanzania, cross-tabulation of producers' nominated constraints with the other information generated revealed:
  - Locality is a strong determinant of constraints identified;
  - Little evidence of linkages between main reasons for keeping the animals and the constraints identified;
  - 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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