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of the United Nations

Guidelines on methods for estimating livestock production and productivity

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Guidelines on methods for estimating livestock production and productivity

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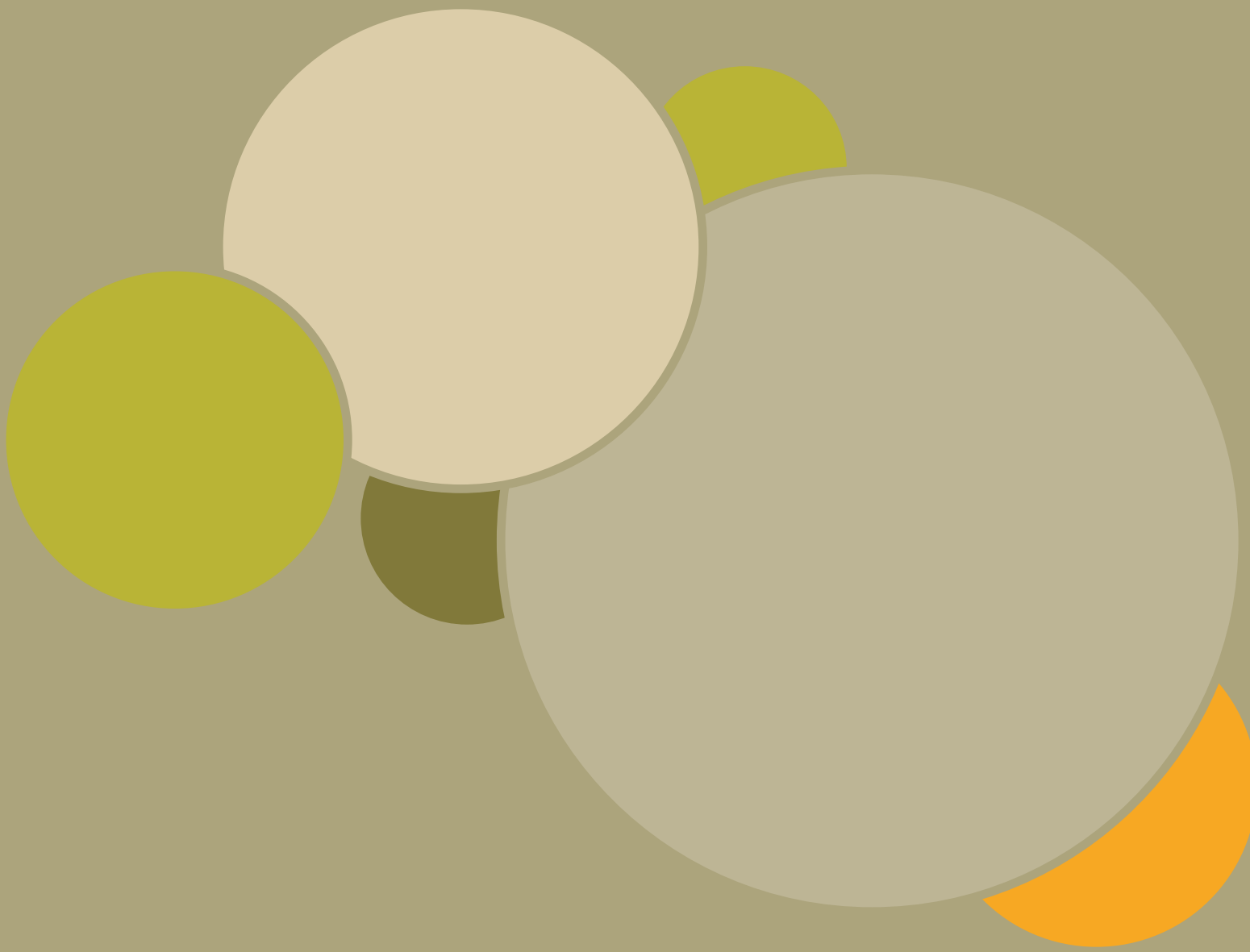

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Acronyms

BCS	Body Condition Score
CAPI	Computer-Assisted Personal Interviewing
CPI	Consumer Price Index
EA	Enumeration Area
EPSEM	Equal Probability SElection Method
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIP	Gross Indigenous Product
GPS	Global Positioning System
GStd	Gold Standard
MSF	Master Sampling Frame
ODK	Open Data Kit
PAPI	Pen-And-Paper-Interviewing
PPS	Probability Proportional to Size
PSU	Primary Sampling Unit
TCF	technical conversion factor
TSL	Taylor Series Linearization
SMS	Short Message Service
SRS	Simple Random Sampling
USAID	United States Agency for International Development
UN	United Nations

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Preface

The Global Strategy to improve Agriculture and Rural Statistics (hereafter, Global Strategy or GSARS), adopted by the United Nations Statistical Commission in 2010, aims to improve the quality and sustainability of statistics on agriculture in developing countries. One of the key components of the Global Strategy's Global Action Plan is its Research Program, which provides support for the research and development of cost-effective methods that serve as the basis for technical guidelines, handbooks and training material to be used by consultants, country statisticians and training centres.

Given the importance of the livestock sector's contribution to the reduction of poverty and improvement of global human health, the Global Strategy has implemented a line of research on Improving methods for estimating livestock production and productivity, one of the key priorities of the Research Program.

These Guidelines overlap to some extent with the final technical report on Improving methods for estimating livestock production and productivity, produced by the University of New England (UNE), Australia (see http://gsars.org/en/tag/Livestock/). In addition to the findings presented in the technical reports of the research line, further additional operational inputs from relevant literature were also used to develop these Guidelines.

These Guidelines are intended to be a reference document providing country statisticians with technical and operational guidance on various aspects of livestock production and productivity statistics, in a broad range of country conditions, with particular attention being paid to developing countries. This document addresses an important gap, given that the most recent FAO publication on the subject dates back to 1992 (FAO, 1992).

Executive summary

In developing countries, livestock production contributes to approximately one third of the value added from agriculture. The prospects of further population growth, urbanization and increased per-capita income are expected to boost the consumption of high-protein animal products such as milk, meat and eggs. Thus, the continued development of the livestock sector has the potential to contribute significantly to the reduction of poverty and the improvement of global human health.

The need for quality livestock statistics is predetermined by their use, varying according to whether they are meant for:

- Development and implementation of food security programmes;
- Development, promotion and monitoring of economic growth, agricultural development and poverty reduction policies; and
- Development of livestock-sector investment strategies, and underpinning these strategies with sound production data.

Recognizing the general need for improved and harmonized livestock statistics as part of agricultural statistics, the Global Strategy to improve Agricultural and Rural Statistics (hereafter, Global Strategy or GSARS) has undertaken a review of the guidelines on collecting livestock statistics established by the Food and Agriculture Organization of the United Nations (FAO; see FAO, 1992). In light of the specific issues relating to, and the need for, data on nomadic livestock, the new methods developed, and the improved technology available for data collection, the Global Strategy has developed and recently published Guidelines for the Enumeration of Nomadic and Semi-Nomadic (Transhumant) Livestock (GSARS, 2016).

These *Guidelines on methods for estimating livestock production and productivity* are directed towards those seeking to design, test and implement data collection activities to measure **livestock production and productivity**, particularly in developing countries. The livestock types bred and the products obtained vary by country and region, according to the national context; therefore, the indicators to focus on for collecting livestock statistics will also vary. These Guidelines focus on the five core livestock types identified, by the Global Strategy, as producing 99 percent of livestock production globally:

- Cattle
- Sheep
- Goats
- Pigs
- Poultry

At international level, the scope of livestock statistics broadly covers statistics on livestock numbers and weight, herd dynamics, livestock production, inputs and production costs, import and export, and prices. These Guidelines list and define the main indicators to be estimated at national and regional level and on an annual basis, grouped into four themes:

- Livestock stocks (number of livestock, structure and dynamics)
- Animal production (meat, milk and eggs) and utilization
- Feed availability and utilization
- Animal health

The data sources and methods of data collection related to the five core livestock types vary according to the livestock system and agricultural holding. The main data sources identified in the field of livestock statistics are agricultural censuses and sample surveys of agricultural holdings. Surveys on industries such as slaughterhouses, dairies and poultry breeding enterprises may be necessary to estimate meat, milk and egg production and utilization. Administrative sources – in particular, administrative livestock registers mainly maintained for veterinary and food safety purposes – can also be a cost-effective data source, provided that the quality of these sources is evaluated and considered good for statistical purposes. The technical conversion factors are largely used when data collection conducted directly from farmers does not exist or is unreliable. To provide reliable estimates of the livestock production indicators, these factors must be regularly updated.

The Guidelines discuss data collection methods and relevant issues of concern, broadened so as to apply to a wide range of users in a variety of countries, and discussed in depth to address the detailed criteria relating to data quality and the drivers of the cost of data collection. Most often, a face-to-face interview is used to collect information from farmers on livestock number and animal production. Computer-Assisted Personal Interviewing (CAPI) tools are increasingly used in both developing and developed countries. Other data collection methods, such as reporting and direct measurement, can be used to collect data, if the quality of farmer declarations is not satisfactory.

These Guidelines provide definitions, geographical aggregations, frequencies of estimation and measurement units for 21 key livestock production and productivity indicators. Without seeking to be exhaustive, the most common items used to calculate these indicators are nevertheless detailed. Specific issues of data collection quality and examples of indicator calculation are compiled. The construction and application of the Gold Standard, as an operation that enables the estimation of the "true" value of indicators and comparison to other methods of estimation, are presented. The construction of the Gold Standard is done mainly through direct measurement in the field.

As livestock statistics are often compiled based on sample surveys, the issues related to obtaining data – including the definition of the target population, the statistical unit, data collection issues and main sampling designs – are discussed. The differences between the classification of livestock-rearing systems, on one hand, and holdings in the household sector and in the non-household sector, on the other, call for the use of different approaches in the actual design and implementation of data collection tasks. These Guidelines focus on the desirable level of disaggregation of livestock data, and its implications for data quality on one hand and sampling strategy on the other.

The anatomy of the costs of data collection is presented and discussed in the context of the decisions to be made in the design and implementation of collection methods, and then as a guide to decision-making on data improvement. The costs associated with building data collection resources through skills and procedures are discussed, and the new technology within these decision frameworks relating to cost and resources is briefly examined.

These Guidelines conclude with a discussion of data integration as a vital component of the Global Strategy. This integration will be accomplished by:

1. the development of a Master Sampling Frame (MSF) for agriculture that includes livestock;
2. use of this MSF within a coordinated data collection program to produce timely and accurate data; and
3. a strategy for effective data dissemination that ensures accessibility.

These Guidelines are in line with the methodology of the Agricultural Integrated Survey (AGRIS), developed by the Global Strategy, in terms of scope and coverage of the livestock statistics, definition of statistical units, and data to be collected. AGRIS is a ten-year integrated sample survey programme featuring one annual Core Module and four pluri-annual Rotating Modules. The majority of the items needed to estimate the key livestock production and productivity indicators discussed in these Guidelines are included in the Core Module, while the remaining items can be found in the Rotating Module on Production Methods and the Environment.

1

Introduction

1.1. BACKGROUND

Accurate data on livestock production and productivity are essential for governments to develop, monitor and evaluate the impact of their policies and investments on the ground, as well as to monitor growth trends in the livestock sector.

The quality of livestock data depends, to a great extent, on the data collection system adopted. Multiple sources and methods of data collection exist, which however need to be integrated into a functional agricultural statistical system. Stakeholders require a multitude of data and tend to not trust the quality of available livestock data. The results of a global survey (Pica-Ciamarra *et al*., 2012) on livestock data and indicators indicates that over 41 percent of the 641 respondents rated as "poor" or "very poor" the quality of available livestock indicators, with only 21 percent assessing them as good (Pica-Ciamarra *et al*., 2014).

Better estimates of livestock production are possible if good-quality and appropriate data are collected on a regular basis. These can then be used to generate statistics according to the agreed methodologies. For this to happen, however, the proposed methodologies should be consistent with the statistical authorities' budget for collecting, analysing and disseminating agricultural and livestock data, considering that budgetary limitations may be an important factor to consider when implementing livestock data collection activities in many developing countries.

In support of the Global Strategy to improve Agricultural and Rural Statistics (hereafter, Global Strategy), the project on "Improving Methods for Estimating Livestock Production and Productivity" sought opportunities to improve livestock data collection methods across a range of commodities. Improvements were sought specifically within the measurement of production and productivity at the level of the agricultural holding. The project also addressed the definitions of the target items to be collected, methods of collection, procedures for benchmarking, and the institutional organization surrounding livestock data collection.

Given the importance of nomadic livestock in arid and semi-arid areas, and to provide practical guidelines to country statisticians, as noted above, separate *Guidelines for the Enumeration of Nomadic and Semi-Nomadic (Transhumant)* Livestock have been produced within the framework of the Global Strategy (GSARS, 2016).

1.2. DEFINITION OF ANIMAL PRODUCTION ACTIVITIES, LIVESTOCK PRODUCTION AND PRODUCTIVITY

Raising and breeding livestock is an economic activity that is a part of agricultural activities in a broad sense. As defined in paragraph 8.5.1 of the World Census of Agriculture 2020 (WCA 2020), the term "livestock" refers to "all animals, birds and insects kept or reared by the agricultural holdings mainly for agricultural purposes. This includes cattle, buffaloes, horses and other equine animals, camels, sheep, goats and pigs, as well as poultry, bees, silkworms etc." Aquatic animals are excluded. Domestic animals, such as cats and dogs, are excluded unless they are being raised for food or other agricultural purposes.

The ISIC group 014: Animal production consists of seven ISIC classes:

0141: Raising of cattle and buffaloes
0142: Raising of horses and other equines
0143: Raising of camel and camelids
0144: Raising of sheep and goats
0145: Raising of swine/pigs
0146: Raising of poultry
0149: Raising of other animals

Statistics in the field of livestock production and productivity broadly cover data on livestock numbers and weight, herd dynamics, livestock production, inputs and production costs, import and export, and prices. Livestock production can be defined as the study of the animal production raised and bred by agricultural holdings and of animal products, such as milk, eggs, meat and skins. Livestock productivity analyses the relationship between the livestock production and the resources used to obtain it. The indicator groups and livestock products to focus on for the collection of livestock statistics will necessarily vary by country and region, depending on national priorities (World Bank, FAO and UN, 2010).

Some of the main indicators of production and productivity that have been identified in the literature include:

- *Total production* indicators, for example total production per farming enterprise and total meat, milk, or egg production;
- *Production per animal* indicators, for example meat, milk or eggs produced per animal observed;
- *Productivity rates*, such as birth rate, mortality rate, off-take rate, etc.
- *Livestock health* indicators, for example instances of and deaths from animal disease, and vaccination rates; and
- *Efficiency indicators*, such as productivity per unit of input for inputs such as labour or feed.

1.3. IMPORTANCE OF LIVESTOCK AND LIVESTOCK DATA

Livestock production contributes approximately one third of the value added of agricultural operations in developing countries (FAOSTAT, 2013). This proportion is expected to increase in the future due to population growth, urbanization, and increases in per-capita income, which will enable the populations of developing countries to purchase greater quantities of high-value foods such as animal proteins (meat, milk and eggs). Continued development of the livestock sector has the potential to contribute significantly to the reduction of poverty and the improvement of global human health.

Livestock data of high quality in terms of accuracy and timeliness are therefore vitally important to guide policy-making and investment decisions, which should be designed to sustain and expand livestock production in developing countries in an appropriately targeted fashion. The use of livestock statistics and their relevance for policy-making and investment decisions are discussed further in chapter 2. Generally, however, the quality of livestock data has been considered inadequate for these purposes. Policy and investment decisions have often been based on insufficient information, leading to sub-optimal allocation of scarce public and private investment resources. Consequently, improving the process by which livestock production and productivity data are collected, as well as the reliability and quality of the data, are efforts expected to pay dividends in the longer term in the form of more targeted and effective investments.

1.4. LIVESTOCK-REARING SYSTEMS

A recurring theme in these Guidelines is the importance of achieving and maintaining a disaggregation of livestock data that is sufficient to enable recognition and exploitation of the variation both within and between diverse livestock systems and agricultural holdings.

It is difficult to reflect the great diversity of livestock systems around the world, in terms of scale and intensity of production, in a single classification system. However, the WCA 2020 identifies three main types of livestock system of the holding: the grazing system (broken down into three subsystems); the mixed system; and the industrial system. The specific situations of different livestock-rearing systems may call for special methods of data collection.

Supporting the integration of national agricultural statistical systems, these Guidelines recommend using the WCA 2020 classification for the sampling and collection of data.

BOX 1.1. TYPE OF LIVESTOCK SYSTEM (WCA 2020, PARA. 8.5.3).

Grazing system is characterized by ruminants (e.g. cattle, sheep, goats and camels) grazing mainly on grasses and other herbaceous plants, often on communal or open-access areas and often in a mobile fashion. In this system more than 90 percent of the dry matter fed to animals comes from grazed grasses and other herbaceous plants. The following categories can be considered:

- *Nomadic or totally pastoral* refers to livestock raised in a situation where the agricultural holder has no permanent place of residence and does not practice regular cultivation. Livestock moves from place to place with the agricultural holder and his/her household, depending on the season and the availability of feed or water.
- *Semi-nomadic, semi-pastoral or transhumant* refers to livestock raised by holders who live a semi-nomadic life. Typically, the holder has a permanent residence to which he/she returns for several months of the year according to seasonal factors. For semi-nomadic and semi-pastoral systems, the holder establishes a semi-permanent home for several months or years and may cultivate crops as a supplementary food source. Herds are moved on transhumance to assure forage and water.
- *Sedentary pastoral* refers to livestock raised by holders who have a permanent residence. Ranching refers to large-scale livestock activities carried out on large areas of land set aside for extensive grazing, where livestock graze mainly on grasses and other herbaceous plants. In recent years, the numbers of nomadic and semi-nomadic holdings are declining and the majority of holdings within the grazing system are sedentary pastoral. Often, ranching is limited to a small number of holdings in the non-household sector (corporations or government holdings), which may be identified through Item 0103 "Legal status of agricultural holder (type of holder)".

Mixed system describes the largest and the most heterogeneous livestock system, in which cropping and livestock-rearing are linked activities. It is defined as a system in which grazing may be largely practiced but more than 10 percent of the dry matter fed to animals comes from crop or crop by-products or stubble; and less than 90 percent of the dry matter of the animal feed is off-farm produced.

Industrial system refers to intensive livestock-raising methods in which (at least 90 percent of the dry matter) of the animal feed is off-farm produced. It often consists of a single species (beef cattle, pigs or poultry) fed in feedlots or other in-house systems of feeding.

In many countries, the population of *agricultural holdings* is divided into two subpopulations: (i) holdings in the non-household sector (commercial holdings) and (ii) holdings in the household sector (holdings run by households or physical persons). Because there are no single definitions at international level, for the sake of coherence, these Guidelines adopt the definitions used by AGRIS (GSARS, 2017).

Holdings in the non-household sector are holdings that are in sectors other than the household sector, such as corporations and cooperatives. Holdings that are operated by a legal person and have a hired manager are included in this definition.

These holdings may also be referred to as commercial holdings. In addition, each country may have its own definition according to farm structure and the local context. In general, commercial farms are well organized, specialized, and large- or medium-sized market-oriented farms. They may be private or governmental enterprises, or run by families or households.

Holdings in the household sector are holdings that are operated by a civil (natural) person or group of civil (natural) persons. Examples are sole proprietorships and most partnerships. However, agricultural holdings whose holder has this legal status may fall outside the household sector if they behave more like corporations, as in the case of limited liability partnerships.

In developing countries, the majority of agricultural holdings with livestock are mixed small holdings engaged in livestock and cropping activities and belonging to the household sector.

1.5. CONTENTS OF THE GUIDELINES

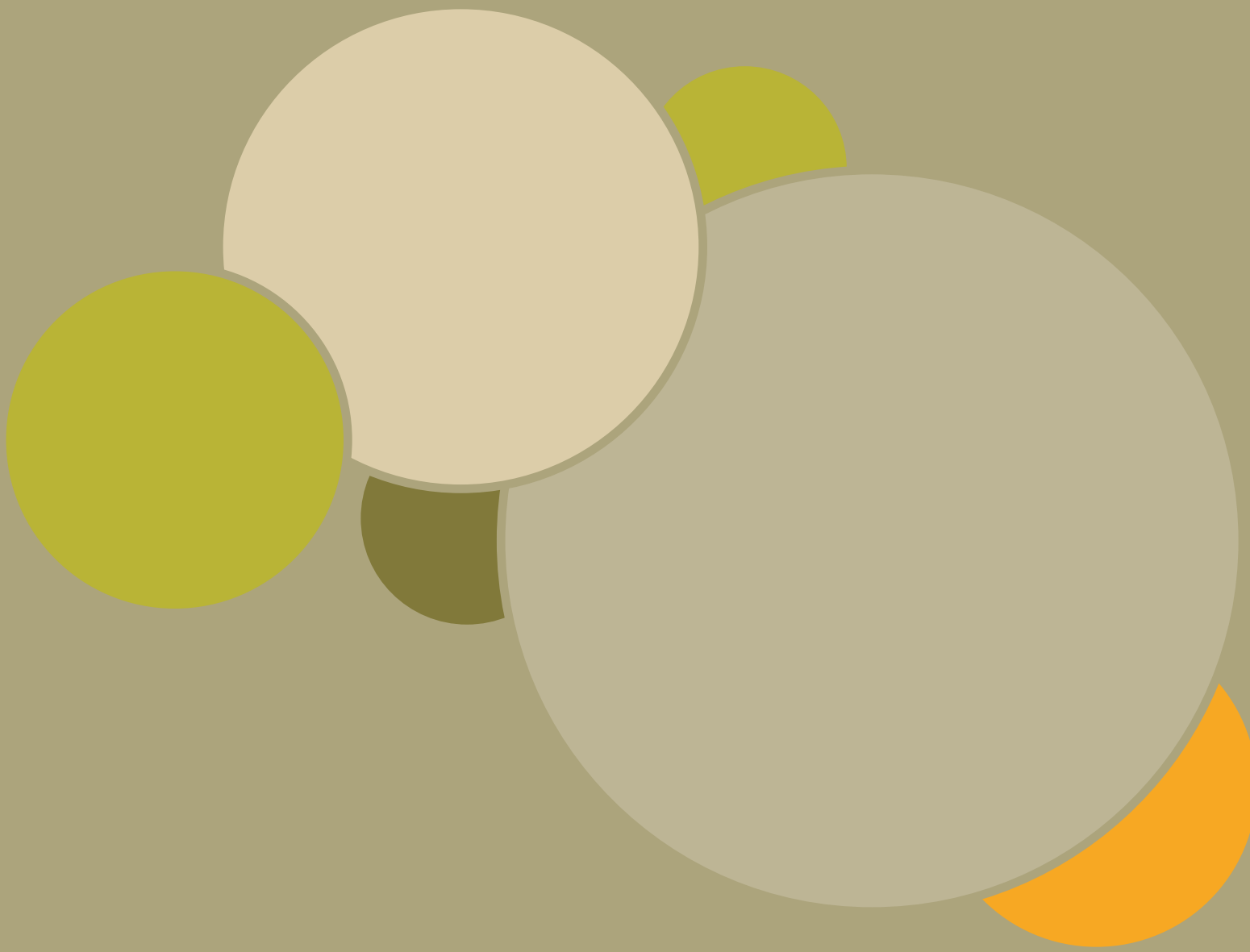
These Guidelines have been prepared as a guide for those engaged in the design, testing and implementation of data collection activities to produce quality statistics on livestock production and productivity in developing countries.

Chapter 2 discusses the relevance and usefulness of livestock statistics to the various stakeholders. The data on livestock are presented in the context of the Sustainable Development Goals (SDGs) and the Global Strategy. The scope of livestock statistics to support the management, policy, planning and benchmarking is defined. The main sources of livestock data are listed and discussed in chapter 3.

Chapter 4 includes the list and definitions of main indicators to be compiled at national and regional level and items to be collected, also providing recommendations for calculating and/or estimating indicators, with examples from different sources: the Global Strategy's AGRIS project, the Global Strategy's project on "Improving Methods for Estimating Livestock Production and Productivity", and others. This includes a summary of indicator calculation, appropriate sources and methods of data collection, and relevant observation units.

Chapter 5 outlines principles of data acquisition: operational issues, collection practicalities, and sampling. It addresses the different data collection methods to be used for holdings in the household sector and for holdings in the non-household sector, as well as data collection issues related to the different livestock systems.

Chapter 6 focuses on the presentation of results and main tables for dissemination. In chapter 7, through the experience of the Global Strategy's project on "Improving Methods for Estimating Livestock Production and Productivity", the resource requirements of livestock data are discussed. These include financial and organizational requirements as well as institutional considerations. Chapter 8 concludes this publication with a discussion of the use of these Guidelines in integrated survey programmes.



2

Relevance and use of livestock statistics

2.1. LIVESTOCK IN DEVELOPMENT

It is recognized that growth in the agricultural sector holds the key to poverty reduction in the developing world, with recent data suggesting that seven out of ten of the world's poor still live in rural areas, and many of these work directly in the agriculture sector as smallholders or farm labourers. Bolstering the agricultural sector in developing countries will therefore not only boost the incomes of the rural poor directly employed by this sector, but will also have significant flow-on effects through increased demand for non-farm products and services (FAO, 2002; World Bank, 2011).

Within the broader agriculture sector, livestock production is a particularly significant and growing source of rural income and growth in the developing world. Approximately 60 percent of rural households in developing countries are partially or fully dependent on livestock for their livelihoods. Livestock rearing provides them with a wide spectrum of benefits, such as cash income, food, manure, draft power and hauling services, savings and insurance, and social status (Pica-Ciamarra *et al*., 2014, pp. 4–5).

Livestock is expected to become an increasingly significant sector of agricultural production over the next few decades, with consumers in developing countries increasingly demanding livestock products such as meat, dairy, and eggs (Pica-Ciamarra *et al*., 2014). Among other things, reliable livestock statistics make it easier to:

- develop and implement food security programs;
- develop, promote and monitor economic growth, agricultural development and poverty reduction policies; and
- develop investment strategies for the livestock sector and underpin these strategies with sound production data.

A global assessment of agricultural data has found that there has been a decline in both the quantity and the quality of agricultural statistics (World Bank, FAO and UN, 2010). While it would not be practical (and certainly not economically optimal) for countries to obtain complete information on agricultural systems from surveys, these authors have found that many developing countries did not have the capacity to collect and disseminate even the rudimentary set of agricultural data necessary to monitor national trends or to inform international development discussions.

2.2. STAKEHOLDERS IN LIVESTOCK DATA SYSTEMS

Stakeholders in livestock production and productivity data include: local and national government ministries and agencies; commodity-specific or statistical agencies and authorities; private-sector actors such as farmers, input suppliers, traders, and consumers; researchers and scientists; civil society actors; and international organizations and the foreign donor community (Pica-Ciamarra *et al*., 2014). Policy-makers and other stakeholders are most likely to support and fund a livestock data collection system that provides authoritative data and indicators relevant to their needs (World Bank, 2012).

BOX 2.1 EXCERPT FROM PICA-CIAMARRA *et al.* (2014, P. 11).

A multitude of stakeholders make use of livestock data and indicators for a variety of purposes. They are mostly dissatisfied with the quantity and quality of available livestock data and indicators (World Bank, FAO and UN, 2010). Public investments are thus called for to enhance their quantity and quality. However, any attempt to improve the agricultural statistical system so that good data and indicators are provided to all livestock stakeholders as per each stakeholder's specific needs is destined to fail.

First, there are many stakeholders with a numerous information needs, i.e. thousands of indicators should be produced to satisfy their demand for information. Second, while some data and indicators are public goods, many others are private goods: these should not be generated by the public sector but by private actors with their own resources. Third, some indicators are needed only in specific circumstances, and it would be inefficient to generate them regularly within the context of the agricultural statistical system, i.e. ad hoc data collection exercises should be undertaken in these cases.

[...] Finally, the public sector acts on budget constraints, which prevent the establishment of a comprehensive agricultural statistical system capable of generating all conceivable livestock-related indicators.

2.3. LIVESTOCK DATA IN THE SDG CONTEXT

In 2015, the United Nations (UN) achieved international consensus on 17 SDGs[1]. The SDGs address the three standard dimensions of sustainable development: economic, social, and environmental. Each SDG has specific targets (169 in total) to be achieved over the next 15 years[2]. The SDG agenda also includes quantifiable indicators of goal achievement (232 indicators) and livestock data is expected to directly or partially contribute to the calculation of some of them.

SDG 2 – End hunger, achieve food security and improved nutrition and promote sustainable agriculture – contains indicators that focus directly on the agricultural sector, while many of the SDGs are relevant to farm-related production activities.

Livestock production data is expected to be used for the calculation of indicators such as:

- 2.3.1 Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size;
- 2.3.2 Average income of small-scale food producers, by sex and indigenous status;
- 2.5.2 Proportion of local breeds classified as being at risk, not-at-risk or at unknown level of risk of extinction.

1 http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E
2 https://unstats.un.org/sdgs/metadata/

Other indicators related to food insecurity and sustainable agriculture are also expected to have a livestock component.

Calculation of the livestock-related SDG indicators requires that quality livestock data (in terms of completeness, accuracy and timeliness) be available at national level for as many countries as possible. Data comparability between countries is also important if supranational aggregates are to be produced.

The need for an integrated survey framework is emphasized in numerous policy documents. To support developing countries in this regard, the Global Strategy has developed a methodology for an Agricultural Integrated Survey (AGRIS). AGRIS is a ten-year integrated sample survey program developed to contribute – among other purposes – to the monitoring of progress towards achieving the SDGs. The annual Core Module (a sample-based survey) is at the foundation of AGRIS, as it collects basic frame information on holdings and on those operating them, as well as data on the agricultural production of crops and livestock. A set of four Rotating Modules provides thematic data on Economy, Labour, Production Methods and the Environment, and Machinery, Equipment and Assets (GSARS, 2017). An overview of AGRIS is presented in chapter 8 of these Guidelines.

2.4. LIVESTOCK DATA IN THE GLOBAL STRATEGY CONTEXT

In 2010, the UN Statistical Commission endorsed the Global Strategy to improve Agricultural and Rural Statistics, an initiative aimed at providing a framework for national and international statistical systems that enables them to produce and apply the basic data and information needed to guide decision-making in the twenty-first century (World Bank, FAO and UN, 2010). The Global Strategy is based on three pillars:

1. The establishment of a minimum set of core data (MSCD) that countries should collect to meet current and emerging demands;
2. The integration of agriculture into national statistical systems to satisfy the needs of policy-makers and other users who rely on comparable data across locations and over time;
3. The provision of a foundation for the sustainability of the agricultural statistical system through governance and statistical capacity building.

Within the context of its first pillar and with the aim to improve agricultural statistical systems, the Global Strategy has developed an MSCD to be collected by countries.

The MSCD covers three dimensions:

- Economic: outputs, trade, resources, inputs, prices, agro-processing; final expenditure; rural infrastructure, etc.
- Social: employment status, education level, household composition, family workers, sex-disaggregated data, etc.
- Environmental: soil degradation, water population, greenhouse gases (GHGs), agricultural practices on water use, land use, etc.

The proposed set of AGRIS questionnaires is also designed to support the collection of MSCDs by generating approximately two thirds of the data thereby required. AGRIS generates all the MSCD-relevant data that must be collected at farm level.

2.5. SCOPE OF LIVESTOCK STATISTICS

Despite the large variety of animal species falling within the livestock sector, globally, five species produce 99 percent of livestock production such as meat, milk and eggs (FAOSTAT, 2013). The Global Strategy identifies these five core livestock types as being the species for which indicators are to be computed (World Bank, FAO and UN, 2010; p. 14):

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

For these five core livestock items, the Global Strategy identifies the following group of indicators:

- Output, including production quantity of core livestock products (meat, eggs, milk, etc.), births and productivity per head;
- Trade, including import and export of livestock;
- Animal stocks, including number of live animals;
- Inputs, including animal feed in quantity and value of core crops for livestock feed;
- Agro-processing, including the quantities of livestock production used in processing food at farm level;
- Producer and consumer prices.

These data would contribute towards the estimation of the two major livestock indicators identified by the Global Strategy (World Bank, FAO and UN, 2010; p. 34):

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

These Guidelines present and discuss the methodological issues arising in data collection related to the five core livestock species, with regard to:

- Animal stocks, structure and dynamics;
- Livestock production and utilization;
- Feed availability and utilization;
- Animal health.

The Global Strategy recommends that countries verify the consistency of the suggested core livestock species and data to be collected with their own information needs and, if necessary, add further items and data.

2.6. RELEVANCE FOR MANAGEMENT, POLICY, PLANNING AND BENCHMARKING

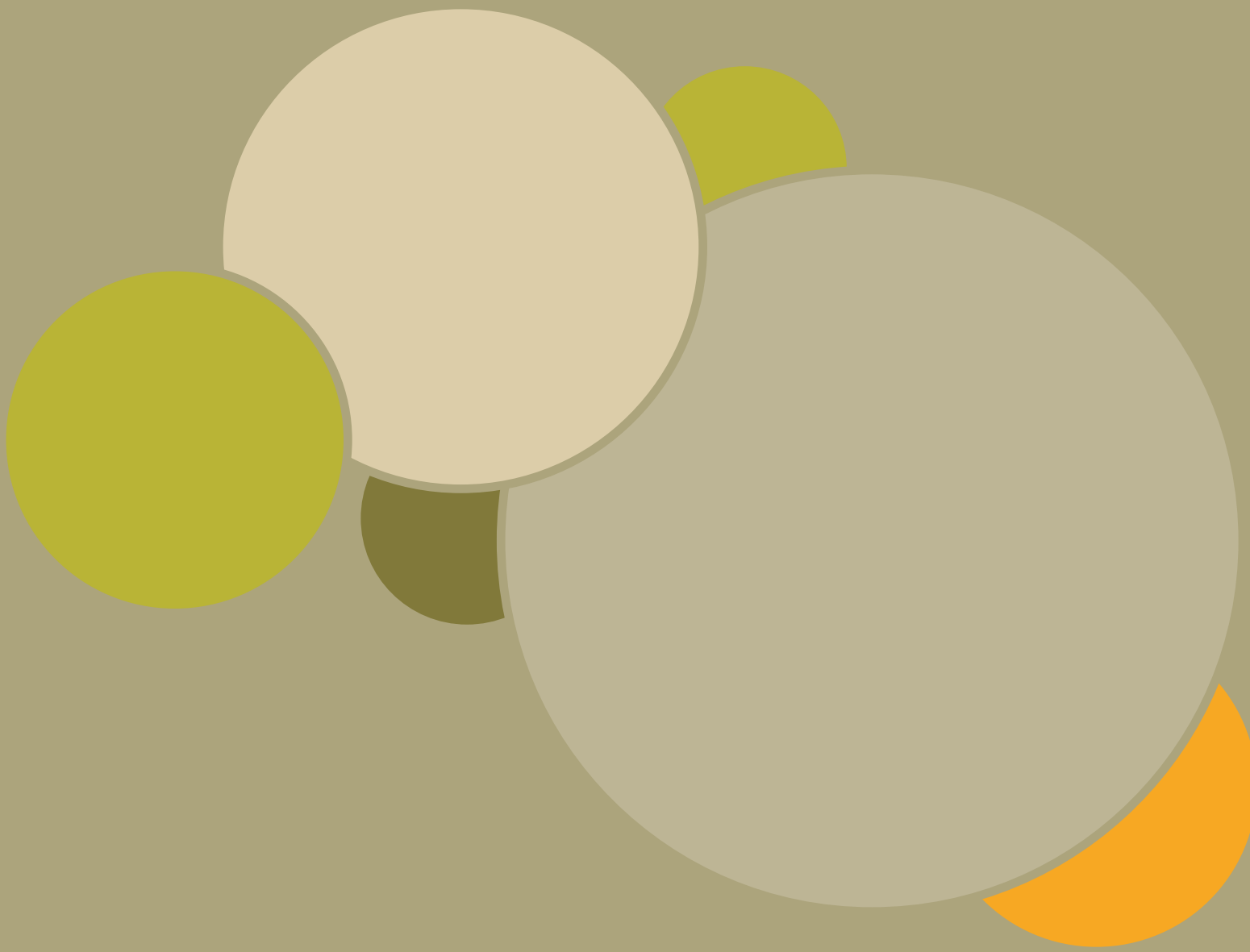
The broad range of livestock stakeholders means that there is a large number of decision-makers that would benefit from improved livestock data.

Production and productivity are central to farm management needs, whether in terms of outputs or inputs. This contributes to the evaluation of daily management options for income generation, food and financial security and risk management, and long-term decisions that affect the household, the community and the physical environment.

Although livestock occupies a relatively minor place in the policy agendas of most countries, there are many important interactions between policy and livestock. These include the areas of water and soil management, land use and greenhouse gas management, food and financial security, and public health. In many countries, public policy plays a role in animal disease control, interfaces with public order and the avoidance of violence (as often seen in grazing-related disputes), and is the provider of the physical and technological infrastructure that powers livestock trading systems and animal movement. Because livestock is a significant employer in rural areas and an important activity in many cultures (FAO, 2002; Pica-Ciamarra *et al*., 2014), public policy is also reluctant to interfere – or to be seen as interfering – with livestock systems. On all these counts, improved data systems will enable the formulation of better policies.

To best serve policy needs, livestock data should cover the population of interest as exhaustively as possible. In the field of livestock statistics, the population of interest is considered to be the heads of livestock of a single species: bovines, sheep, goats, etc. For the purposes of data collection, the agricultural holding breeding livestock is commonly defined as the statistical unit (observation unit), the basic unit for which data are being collected.

To cover the livestock population exhaustively, the data collection activities must account for all agricultural holdings with livestock. This means that all agricultural holdings with livestock must be enumerated, in the case of a census, or represented, in the case of a sample survey. In reality, many countries apply different cut-off criteria to reduce the costs of data collection or for other operational reasons. Sometimes, agricultural holdings are excluded from the survey because of their size, importance or location. In other cases, entire areas, such as remote areas, urban areas, areas of conflict, etc. are excluded from the data collection exercise. In developed countries, a threshold is often applied based on the minimum size of the holding or coverage of a certain percentage of the total population of livestock. Such thresholds lead to exclusion of the very small units, usually hobby farmers, whose livestock production is considered insignificant in light of the total livestock production of the country. However, in developing countries, the majority of livestock farms are very small and rely on their own production to procure food or cash. They may account for the majority of the poor households at risk of food insecurity and should be included in censuses and surveys. These small holdings are expected to be the subject of livestock development and investment policies, poverty-reducing policies, etc.; their omission from the statistics would deprive stakeholders of the information required to formulate, implement and evaluate relevant public policies.



3

Main data sources and data collection methods

Livestock data may originate from a variety of sources, such as livestock, agricultural and non-agricultural censuses/surveys, commercial records, registers, administrative records, etc. The variety of methods of data collection often leads to the duplication of the efforts to produce data. This means that the same data items or indicators may be produced from different sources, with different qualities. In such cases, stakeholders are obliged to select between sources, making their own assessment of data quality, while the country spends scarce human and financial resources on the collection of duplicated items. On the other hand, not all items and indicators may be found in one single source, while using multiple sources for compilation of the necessary set of items and indicators may not be possible if coherence between sources is not ensured. Furthermore, some sources may be more appropriate than others to collect data on agricultural holdings, depending on their status (household or non-household sector), or to collect specific items or indicators.

The availability and quality of sources vary from one country to another and many countries use more than one source for the data sets on livestock and livestock production. Conducting a quality assessment of the existing sources would help countries to identify the gaps and duplications in the data and to select the most suitable data source for different items, types of rearing systems or holdings.

The compilation of data from different sources would require their coherence and additionality. Therefore, the integration of sources into a functional agricultural statistical system that includes livestock, as recommended by the Global Strategy, is essential.

3.1. POPULATION, AGRICULTURAL AND LIVESTOCK CENSUSES

Population censuses

Population censuses are certainly the most regular census conducted in countries. However, in classical or traditional population and housing censuses, data on the agricultural activities of the household are not collected. In practice, some countries add some data on agriculture including livestock if there are no other sources of agricultural statistics. Basically, the main relevant livestock statistics that can be computed from these censuses concern the socio-demographic characteristics of household members involved in livestock production as an own-account activity or as employees (GSARS, 2015). Therefore, the population census is not a relevant source for livestock production and there are severe limitations upon building a frame from this census for agricultural or livestock surveys (FAO/UNFPA, 2012).

Agricultural census

The most significant enumeration of statistical data on livestock for any given country occurs through its agricultural censuses. These are usually conducted every ten years, although some countries run one every five years (FAO, 2005). FAO's newest decennial programme covers years 2016 to 2025. The WCA 2020 has been developed and is expected to provide the basis for implementing agricultural censuses in FAO Member Countries during this period.

Agricultural censuses usually have a good coverage of permanently settled agro-pastoral livestock. However, an important part of nomadic and transhumant livestock may not be covered by these censuses. In some countries, such as India (Republic of India, 2014), a specific livestock census is also routinely conducted. In other countries, such as Mali, specific livestock censuses covering only nomadic and transhumant livestock have been conducted (GSARS, 2016). These complete population enumeration surveys are usually conducted by the relevant national statistical authority, with some collaboration between different ministries (Pica-Ciamarra *et al*., 2014, p. 30). The censuses collect data on livestock numbers by breed and type (NBS, 2011; ABS, 2014a; Republic of India, 2014) and may also acquire data on livestock production such as milk, egg and wool production (IBGE, 2006; Nsiima *et al*., 2013). Some countries, such as the EU Member States, Canada and New Zealand, also collect information based on sex and age groups per livestock type (Statistics Canada, 2010; Statistics NZ, 2012).

BOX 3.1. FARM STRUCTURE SURVEYS IN THE EU.

Comprehensive farm structure surveys (FSS) are carried out by EU Member States. Every ten years, a basic survey or full-scope agricultural census is conducted, followed by intermediate sample surveys carried out twice between these basic surveys. The EU Member States collect information from individual agricultural holdings, covering:

- land use and land tenure;
- livestock numbers (by type of livestock, sex, age group/ weight);
- rural development and other gainful activities of the farm (for example, activities other than agriculture);
- management and farm labour input (including age, sex and relationship to the holder);
- agricultural production methods.

Regulation (EC) 1166/2008 of the European Parliament and of the Council of 19 November 2008 on farm structure surveys and the survey on agricultural production methods sets the framework for the implementation of the FSS in the years 2010 to 2020.

The census being a complete enumeration of livestock holdings, it is generally used to build or update the frame for sample surveys on livestock. It also provides aggregated data at the lowest geographical level on the number of livestock and herd structure.

Censuses present some drawbacks in terms of data quality that are well known but not easy to overcome, especially in developing countries:

1. Censuses are expensive operations and, consequently, most developing countries do not carry out agricultural censuses every ten years, contrary to FAO recommendations;
2. Censuses do not always cover the entire population for practical, financial or other reasons, and very small holders or entire areas may be excluded from the census. If complete coverage is not ensured during the census, the omitted part has to be estimated;
3. Often, data collection for the censuses is carried out over a long period of time (three to five months, or even longer), with the reference date for the number of livestock being the date of the survey. If the movement of the holding's animals was considered (entries and exits), the total number of animals obtained from the census would not be reliable. In this regard and in order to improve data quality, the recommendation is to establish one fixed reference date for the number of animals throughout the census and to reduce the period of data collection as much as possible;
4. The time for data processing may be very long and the time lag between the reference date and the date of dissemination of the results may be excessive. In such cases, the data would be outdated.

In light of the above, census data are suitable for analysing animal structure but not the number of livestock and production on a regular basis. Other sources should be considered to estimate these data.

3.2. PERIODIC AND AD HOC SAMPLE SURVEYS

Sample surveys are used for regular data collection between censuses. According to the capacity of the data-collecting institution in terms of human and financial resources and the data precision requirements, the sample size can vary significantly. However, it usually ranges between 1 percent and 10 percent of the entire agricultural holding population. For example, EU Regulation 1166/2008/EC sets the coverage and precision requirements for the main agricultural characteristics. According to the different national contexts and agricultural structures, the sample size varies between 3 percent to 15 percent of all agricultural holdings. For example, for the FSS 2013, it was approximately 11 percent in France and about 4 percent in Italy[1].

Sample surveys are often considered the best and relatively cost-effective information source available to determine livestock numbers and productivity constraints, as well as opportunities for investment or adjustments to agricultural policy, relevant at the on-farm level. Policy-makers may be interested in conducting a sample survey across an entire livestock sector within a country, or may choose to focus on particular livestock subsectors or geographical regions (Pica-Ciamarra *et al*., 2014).

1 For more information on the sample size of the FSS in different EU countries, see the National Methodological Reports, Section 12.3.d, Monitoring of response and non-response: http://ec.europa.eu/eurostat/web/agriculture/national-methodology-reports

Periodic surveys of agricultural holdings are carried out regularly at certain time intervals (annually, semi-annually, quarterly, monthly, etc.). They are usually used to provide the most detailed data on livestock, livestock production and productivity. For example, in the EU's 28 Member States, the collection of livestock indicators from annual or biannual sample surveys is required by law (Regulation 1166/2008/EC). These surveys provide timely data on livestock production in the years between agricultural or livestock census data collections.

Due to the smaller size of the population surveyed, sample surveys are often capable of collecting more comprehensive data than agricultural or livestock censuses. For example, the Ethiopian annual livestock survey utilizes a paper-based structured questionnaire technique and collects a comprehensive range of livestock indicators, including the number of cattle, sheep, goats and other livestock by age category and productive use, the number of poultry birds, milk and egg production, livestock diseases, vaccinations and treatments, the number of births, purchases, sales, slaughters and deaths, and livestock feed utilization.

Surveys that are not carried out on a regular basis but are designed and carried out for specific objectives and usually restricted to particular areas are called ad hoc surveys.

3.2.1. Identification and definition of systems

To collect information using surveys, the animal production systems must be clearly identified and defined. The categorization of data usually requires identifiable categories that are:

- Mutually exclusive (separated by boundaries that are clear to providers and users of information);
- Exhaustive (the list represents the full list, or the list of the most frequently expected selections);
- Manageable in number (the list is short enough to be usable, a situation usually enabled by inclusion of a category called "other" to cover less frequently employed options).

3.2.2. Periodic surveys of agricultural holdings

According to their objectives, periodic surveys may be specialized to obtain data on livestock and animal production (sometimes even on a single species), or may be complex and also collect data on the holdings' cropping activities.

In many countries where the majority of the agricultural holdings are mixed (having both livestock and cropping activities), combined annual or semi-annual sample surveys are used to collect data on all farm activities, including livestock.

Household income-expenditure surveys, such as the Living Standards Measurement Survey (LSMS) or the Statistics on Income and Living Conditions (SILC), are used in many countries to collect – among other data – statistics on the number of livestock and on animal production.

BOX 3.2. EXAMPLE OF PERIODIC SURVEY ON LIVESTOCK HOLDINGS: THE LIVESTOCK PRODUCTIVITY SURVEY.

Agricultural or livestock censuses enable the collection of data on a number of structural variables on livestock, such as the stock of animals, livestock equipment, etc. However, specific surveys are required to collect reliable data on other important structural variables on livestock productivity, such as the growth rate, mortality rate, etc. Livestock productivity surveys are usually conducted over one year and enumerators visit the field at least one time per season to collect demographic and/or production data. One methodology to conduct livestock productivity surveys, which was developed by the French Agricultural Research Centre for International Development and is used by a number of countries, is the 12MO method. Technical details of this methodology are available in Lesnoff *et al.* (2010). Usually, countries implement productivity surveys every five years as the herd dynamic parameters are unlikely to vary every year. The survey is conducted periodically and technical coefficients are compiled and used the following year, when the survey is not conducted. It is preferable to conduct the survey during a "normal" year, that is, a year when the country or area does not experience extreme events.

3.2.3. Periodic surveys on livestock input and output industry

The periodic surveys of agricultural holdings are not always the most reliable and efficient sources to collect data on livestock production and productivity. For certain variables – such as animal live and carcass weight, availability of agro-industry feed, and causes of death and type of veterinary services provided to agricultural holdings – the relevant industry provides more reliable estimations based on direct observations and measurements recorded in administrative registers and accountancy books, which are subject to administrative control.

For indicators deriving from these data, specific industry surveys on the activity of slaughterhouses, other slaughtering points, agro-industry, veterinaries, etc. are suggested by these Guidelines, as they are generally more efficient.

Similarly to the periodic surveys of agricultural holdings, surveys of industry can be exhaustive (censuses) or sample surveys.

3.2.4. Household income-expenditure surveys

In many countries, the surveys relating to household budget are used to collect, among others, data on the household's livestock breeding activities.

By design, these surveys exclude non-household units, such as enterprises whose share in the total animal production of the country may be significant even in developing countries.

Another inconvenience when using these surveys for livestock statistics is that they usually focus on other aspects of household development, and the questions related to livestock statistics may be underestimated or their estimates may not possess the required precision.

3.2.5. Focus group data collection

The focus group refers to a group-based questioning in which a group of respondents are asked to provide an aggregated response to survey questions. The focus groups are presented in these Guidelines as a cost-effective way to collect some types of information, namely:

- data that are common, or likely to be common, across a groups of survey respondents (such as rainfall within a confined geographic area);
- data relating to which discussions among respondents are likely to generate higher-quality data than is likely to be obtained from a collective of individual responses;
- data that identify the distribution of views, practices or experiences on a variable or subject that is sufficiently complex, to which the group response would add context.

Indicators arising from focus groups are associated with these themes.

For example, in relation to poultry:

- Proportions of a poultry-producing group engaged with (i) egg production; (ii) meat production; or (iii) both;
- Of the egg producers referred to above, the proportion that (i) sells all their eggs; (ii) consumes all their eggs; or (iii) hatches some or all of their eggs;
- Of the egg producers referred to above that hatch some of their eggs, the proportion that (i) removes eggs from other hens' clutches for establishment of a sitting; (ii) allows single hens' clutches to build up; or (iii) employs some other method.

Group data collection can entirely replace data collection at the level of agricultural holdings or households in case of surveys, and expert estimates in case of administrative reporting. It can also be used to collect a part of the livestock productivity indicators (technical coefficients) if the quality obtained through farm-based data collection is not satisfactory. A more general set of considerations surrounding choices between group and individual data collection are presented in table 3.1.

When the focus group questionnaire is administered to communities selected with probability (for example, those primary sampling units, or PSUs, in a probability sampling design) and completed by eligible respondent farmers (village head, assisted by most knowledgeable persons), then the reliability of estimates from the survey can be measured. Since the group data collection is expected to complete the data collection from agricultural holdings, the focus groups can be defined for the same sample of Enumeration Areas (EAs) selected for the sample survey of agricultural holdings. However, if the survey questionnaire is administered through random focus group discussions, then the reliability of the resulting estimates cannot be quantified.

TABLE 3.1. GROUP VERSUS INDIVIDUAL APPROACHES TO DATA COLLECTION.

Consideration	Group data collection	Individual data collection
Desired depth of engagement of participants	Strong	Weak
Clarity of questions and responses	Moderate	Strong
Ease of capturing individual farm effects	Limited to proportional piling for establishing distribution of individual effects	Strong
Precision of "lists" versus meaning of results	Lists readily available, with little insight into interpretation. Ranking of listed items subject to peer pressure.	Lists difficult to assemble. Ranking from an existing list is achievable.
Flexibility	Strong	Weak
Efficiency of resource utilization	Strong where capacities are fully utilized by large numbers of participants	Can depend on the logistics associated with the sampling strategy
Building ongoing relationships	Useful	Less useful
Access to gender and minority information or participants	Achievable either by subsampling at or before the workshop, or the creation of special sessions at the workshop	Depends on who is available and approachable at the specific time of the survey interview
Control over local partners' action	None	Some
Mapping and other respondents' identity issues	Loss of anonymity among peers and neighbors is inevitable. Locations and farm-specific information is provided subject to few checks.	Anonymity is maintained. Respondent statements about farm size and operations, and other important details, can be checked to some extent.
Payment issues	Payments made to participants are usually necessary, at least in the form of transport allowances and meal expenses	Payments are usually not made
Sampling issues	Left to local contacts, selection for a workshop or grouped activity may contribute to a biased sample, or to an inaccurate sample such as one featuring participants that adopt roles related to payments being made	Structured and meaningful sampling is easier to achieve

3.3. COMMUNITY-LEVEL DATA COLLECTION

Some types of community-level data are of high relevance to planning and evaluating livestock development programmes, in realms such as availability and quality of common pastures, markets, veterinary and extension services, road infrastructure, etc.

Community-level data collection was introduced in the WCA 2010 and its application was retained in the WCA 2020 (WCA 2020, chapter 9).

Items collected through community-level data collection should be limited to key administrative information or aspects of the community that are well known to its people, such as weather conditions, economic activities, and whether certain infrastructure and services exist. The WCA 2020 provides a list of possible items for community surveys (WCA 2020, para. 9.21).

It is important to note that community-level data collection should not replace individual data collection from agricultural holdings, in particular on livestock number and animal production. However, the existing administrative records or estimations can be used for cross-checking, in case of agricultural censuses or other data collection approaches that envisage full enumeration at community level.

3.4. ADMINISTRATIVE DATA

Administrative data sources are, for example, government records, reporting systems and registers. For the purposes of these Guidelines, the definition used by the Global Strategy is applied: "administrative data is defined as information collected primarily for administrative (not statistical) purposes by government departments and other organizations usually during the delivery of a service or for the purposes of registration, record keeping or documentation of a transaction". Ways to improve and use administrative data in agricultural statistics are discussed in the technical reports of the Global Strategy line of research on administrative data: for a full list of available publications, see http://gsars.org/en/tag/administrativedata/.

3.4.1. Administrative reporting system

Administrative reporting is one of a vast number of government functions and services that are commonly devolved to local, municipal or regional government agencies. Data collected on a regular basis (usually monthly or quarterly) and at the lowest administrative unit, such as the village or district level, is sent up the chain to the national statistical agencies that process and collect various key livestock data and statistics (Baker and Pica-Ciamarra, 2010).

This practice may introduce difficulties in effective livestock data collection and management, among which the risk of duplication and inconsistent treatment of variables and indicators, as outlined above. However, more significantly, from the point of view of the management of a livestock data collection system, there is divergence between the responsibilities, resource availabilities and reporting processes that characterize different government agencies. In general, central ministries of agriculture or livestock co-operate well with local government agencies in data collection. Such local government agencies frequently include agricultural and livestock extension staff, as well as those active in land and water management and infrastructure, public health, poverty reduction, and a range of activities with links to livestock.

Central government demands for livestock data should recognize the actual and perceived addition to the responsibilities and workloads of local government staff. This extends to a need to consider both overall workload and seasonal and competing demands (an example of the former being annual vaccination programmes), as well as annual or periodic statistical reporting requirements that are already in place (such as census responsibilities). Some general guidelines are provided below.

- Using existing data collection points and personnel can help to reduce the perception of excess additional work. Examples include performing data collection at municipal slaughterhouses or livestock sales facilities, where various forms of data are already collected and record-keeping facilities are already in place;
- Costs relating to data collection that are borne by the local authorities – such as additional fuel and vehicle expenses, casual labour and meals and accommodation – must be covered by the survey endorser;
- Linkage to existing responsibilities (for example, preparedness for disease epidemics; monitoring of kill at local slaughterhouse; movement control of animals) is desirable;
- Local government agencies provide important – indeed, vital – links to local businesses and communities, and thus enable communications and logistics surrounding livestock data collection. Steps must be taken to improve, or at least not erode, this inherent trust and co-operation. Rapid and appropriate feedback from data collection, agreeable and respectful collection procedures, and punctuality are all necessary in maintaining local authorities' links to their communities and should be enabled by livestock data collection activities wherever possible.

3.4.2. Administrative registers

Many countries collect data on animal identification, animal movement and animal health and disease in administrative registers. An example is the EU's use of livestock tracing systems and livestock registers, such as the Animal Identification and Registration System (Regulation No 1760/2000/EC), the National Livestock Identification System in Australia (Animal Health Australia, 2013) or the Brazilian Bovine and Bubaline Identification and Certification System (Lima *et al*., 2006). These systems capture identification information on livestock, tracing the births, deaths and movements of individual animals; when combined with regular checks, such as on-farm inspections, these systems can provide an accurate record of the size and composition of livestock populations at any given time, provided that data in the register is regularly updated.

Generally, this type of system is limited to larger livestock such as cattle, which are tagged with official ear tags that provide a unique number for each animal. The EU has also established an identification and registration system for sheep (Council Regulation (EC) No 21/2004).

The electronic tagging of livestock can provide for the remote collection of production data from grazing livestock (Atzberger, 2013).

Administrative registers are established with specific administrative purposes and are subject to quality assessment before being used for statistical purposes. Quality issues that often arise during such assessments are related to:

- Definitions: the registration unit is not coherent with the statistical unit (for example, the registration unit may be the bovine animal and the livestock breeder, while the statistical unit may be the agricultural holding);
- Coverage: not all statistical units are included in the register, animals may be incorrectly identified (such as animals with only one or no ear tag);
- Update: failure – because of delay or absent or incorrect information – to report births, deaths or movements (moreover, these are the most frequently detected deficiencies in existing systems);
- Accessibility: data from the administrative source are often not accessible to statistical offices.

3.4.3. Compatibility of data

Administrative data has inherent limitations:

- The collection and recording of livestock data may be forced to conform to staple crop production, so that productivity measures (such as the annual production of calves) or estimates are difficult to interpret;
- Basic variables such as daily and annual production measures may be collected in a manner that is not compatible with other collections;
- Duplication of animal sales and movement data is a potential issue. Animals that are sold or transported more than once will appear multiple times in records, and will appear again where slaughter numbers are recorded;
- Limited supporting data appear alongside basics such as counts of animal numbers, particularly as associated with breeds, age groups and management systems;
- Management systems may be poorly defined or defined according to local norms that may or may not accommodate farm management practices. For example, data on poultry meat and egg production may be combined, or data from sow and piglet systems may be combined with data from pig fattening farms.

3.5. TECHNICAL CONVERSION FACTORS

Government statisticians make use of technical conversion factors (TCFs) in estimating livestock production in the different production systems (Blum *et al*., 2013). TCFs are widely used by the scientific community to convert an easily measured livestock variable into a different unit of measurement. The following are examples of how TCFs are utilized to derive estimates of livestock indicators.

- The milk production of a country can be derived by multiplying the number of milking cows estimated from a sample survey with the TCF of milk yield per cow per day and with the duration of the lactation instead of directly estimating the milk production from a sample survey. This may be a preferable approach when there are many missing items or a significant degree of non-response in the survey. Also, milk production may not have been included in the questionnaire, but only the total livestock by species and age group;
- Using another TCF, carcass weight per animal species, meat production may be estimated when only information on the number of animals slaughtered is available;
- The TCF of eggs per laying hen per clutch enables the production of estimates on egg production by only counting the number of laying hens and the number of clutches per year.

In general, fixed TCFs are often used to produce livestock indicator estimates for countries, especially those with many small holdings that do not regularly record their production. TCFs are known to adequately reflect long-term trends; however, they ignore short-term variations which could be substantial, especially with regard to poultry and small livestock, that may experience sharp seasonality due to disease outbreaks or religious and cultural events .

The TCFs used by national statistical offices, however, are rarely based on a nationally representative sample. The TCFs are determined on the basis of expert opinions, grey literature, or are taken from neighbouring countries; they are infrequently, if ever, updated. The consequence is that trends accounted for in official statistics may not truly reflect actual livestock production because of measurement errors resulting from TCFs.

Chapter 4 of these Guidelines discusses the construction and application of the Gold Standard for data collection and estimation of indicators. The Gold Standard represents a direct measurement of items such as animal live weight and growth, animal production (milk, eggs, etc.) per productive animal, etc. It is a costly operation as it requires multiple visits to farmers and enumerators must possess special skills to select the animals to be observed, to approach and handle them for measurement, and to use different measurement tools. Therefore, the Gold Standard cannot be implemented annually on a large sample of farms. However, if carried out every three to five years on a small subsample of the regular sample for livestock statistics, it can be used, among other purposes, to update the technical coefficients on livestock productivity and replace the relevant questions to farmers.

TCFs may also be improved by conducting small but well-planned experiments. To determine the milk yield per cow per day, the daily milk production of selected milking cows can be measured for a specific period. As milk production may vary across breeds, milking cows from different breeds can be selected for the experiment. To determine whether milk production varies by season, measurements of milk production can be taken in different seasons for all the milking cows in the experiment. Similar experiments can be done to improve existing TCFs or develop new ones.

Where livestock conversion coefficients are regularly updated, less data on livestock production will be required from surveys or administrative records (Pica-Ciamarra *et al*., 2014, p. 65) and the quality of livestock indicators estimated from dated technical coefficient values will increase. As a first step towards ensuring high data quality and the use of up-to-date conversion coefficients, an inventory of the current conversion coefficients routinely used to generate livestock indicators must be compiled.

Some examples of livestock technical coefficients are given in box 3.3.

BOX 3.3. LIVESTOCK TECHNICAL CONVERSION FACTORS. EXCERPT FROM PICA-CIAMARRA *et al.* (2014; P. 63).

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

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

3.6. INTEGRATED SYSTEMS

Although the integration of data systems refers primarily to cross-disciplinary action or multiple purposes and means of data collection, desirable features of data from any set of multiple sources include comparability and consistency (and other key quality measures) across sources, and avoidance of duplication. These considerations are discussed in the context of livestock data in chapter 8.

3.7. DATA COLLECTION METHODS

The method of data collection to be used is defined by the data collection strategy, which depends on the local context, the data items to be collected, the precision required, the knowledge and skills of the enumerators and respondents, etc. The main data collection methods are:

3.7.1. Interviews

The person from which the data is collected is the respondent. The person collecting the data is the interviewer or enumerator. The interview is based on farmer recall or estimation and thus relies on the respondents' knowledge and willingness to cooperate. If the accuracy and reliability of farmer declarations are not satisfactory, the interview may include some objective measurement techniques in the questionnaire design.

Most often, a face-to-face interview is used to collect information on livestock number and animal production. Interviews conducted on the telephone are used as a stand-alone technique; however, this method is frequently applied to follow-up processes or to clarify data collected from previous face-to-face interviews.

In the past, the most commonly used data collection tool was Pen-And-Paper-Interviewing (PAPI), in which enumerators would use a paper questionnaire. Being a personal interview during which data is collected face-to-face with the respondent, PAPI has many advantages and a higher response rate. However, it has some disadvantages, such as:

- additional costs related to printing the questionnaires and data entry;
- longer time required for data processing because of the need for data entry and control of the paper questionnaires;
- interviewer concerns related to control of the interviewers' fieldwork.

In recent years, as an alternative to paper-based surveys, Computer-Assisted Personal Interviewing (CAPI) tools have been increasingly used in both developing and developed countries. CAPI is an interviewing technique in which the respondent or interviewer uses a computer, tablet or mobile phone to record the answers to survey questions. Thus, CAPI has the same advantages as PAPI, as it remains a face-to-face interview, while overcoming its main disadvantages.

Examples of CAPI software are Survey Solutions, CSPRO mobile and Open Data Kit (ODK). The benefits of this approach include (for further information, refer to GSARS, 2017):

- Maximizing timeliness: immediate upload and storage of data on a remote server using mobile data networks, immediate availability of data to survey managers for data checking, and incentive for farmers to take part, if they have immediate 'live' access to useful data during collection;
- Reducing costs: no need to digitize manually or scan paper for data entry; no need for storage to keep the paper records for future reference; no need to print;
- Improving data quality: incorporate data validation checks, automate coding and perform the monitoring while the survey is being conducted;
- Facilitate the work of the enumerators in the field: no need to carry papers or books, more secure protection of respondent data by reducing the risk of loss of questionnaires during data collection and transmission.

The use of tablets and smartphones (Dillon, 2012; Mille *et al*., 2015), especially those equipped with GPS tracking to collect data, have shown significant potential in reducing the time lag between data collection and dissemination, while also improving data quality (World Bank, FAO and UN, 2010; p. 20).

3.7.2. Reporting

Reporting or self-administrated surveys are based on sets of questionnaires completed by the respondent without the assistance of an interviewer. This technique requires a certain level of literacy on the part of the respondent and his or her willingness to reply; it is usually backed up by legal requirements (an obligation to report). Usually, the reports are filled in using the data in the records kept by the respondent.

The mail-out/mail-back paper-based questionnaires technique is commonly favoured, especially in developed countries, where clearly defined livestock-producing companies can be surveyed at a relatively low cost.

As more advanced techniques, web-based surveys and data collection forms (Ladner *et al*., 2000; NASS, 2009a, 2009b and 2013) are used. While, in developed countries this technique is often offered alongside mail-out/mail-back paper-based surveys, the uptake rate of this collection technique by livestock holders has generally been low (USDA, 2011; Tobin *et al*., 2012; ABS, 2014b). Follow-up procedures using telephone calls and site visits may improve the associated response rates. Some countries could also enforce sanctions on the non-respondent farmers if they fail to participate in data collection.

On the other hand, the recording of livestock slaughter data electronically, especially by government inspectors, is commonly employed in developed countries (NASS, 2009c and 2009b).

3.7.3. Direct observation and measurement

Direct observation or measurement is considered the most accurate method for a number of indicators for which farmer knowledge or estimation are not reliable. Direct observation and measurement techniques can be incorporated in the administration of the questionnaire. Instead of relying only on farmer recall or estimation, production indicators such as animal dimensions – weight, heart girth measurement, shoulder height measurement, or body condition score – are measured and the trained enumerator also visually counts the livestock. In other cases, an extension officer or a market agent observes (in a more or less structured way) production-related variables and fills a data spreadsheet (United Republic of Tanzania, Ministry of Livestock and Fisheries Development – MLFD, 2012). Enumerators can also use photographs as prompts for breeds.

Visual observation and direct measurement are perceived to be more accurate than farmer recall. However, because of the likely high cost of direct measurement techniques, particularly if each animal in the farm has to be measured, they are not used in surveys often, except in the case of a particularly well-resourced data collection program. Instead of using direct measurement or visual observation to collect data from all the sampled farmers, this can be used for a subset of the sample. This is a cost-effective approach that would also commensurately improve the quality of data. These measurements can also be used to improve the TCFs. Direct measurement is one of the approaches used to establish the Gold Standard discussed in chapter 4.

4

Indicators and items

This chapter presents the concepts, definitions, geographical aggregation, frequency of estimation and measurement units of main indicators related to livestock production and productivity (tables 4.1. to 4.6.). A non-exhaustive list of the most common items used for the calculation of these indicators is provided in table 4.7.

The sources of data and different methods for calculating of some of the indicators are discussed in section 4.3. Section 4.4 discusses the construction and application of the Gold Standard as a tool to measure reporting error and to update some of the technical coefficients related to livestock production and productivity.

4.1. INDICATORS

Developed countries maintain large sets of data and long time series, built from regular sample surveys and reliable administrative sources. In developing countries, the institutional capacity is not sufficient to ensure a regular production of large data sets in livestock statistics. Instead, these countries should aim to cover at least the MSCD proposed by the Global Strategy and national priorities, while focusing on producing quality data in an integrated statistical system.

These Guidelines discuss the sources of data and data collection methodologies for the following groups of indicators:

- Livestock stocks;
- Meat production;
- Milk production;
- Egg production;
- Feed availability and utilization;
- Animal health.

Indicators related to animal watering that are usually not estimated on an annual basis, but that may be very important to countries that suffer from irregular water and rain distribution, are discussed in section 4.3.

TABLE 4.1. LIVESTOCK STOCKS.

Concept	Definition	Common items collected	Geographical aggregation	Frequency of estimation	Measurement unit
Number of animals	Includes domestic animals of the following types: • bovine • sheep • goats • pigs • poultry that are kept on the territory of the country on the given reference day. Other species of animals can be included, depending on national priorities. If the country's livestock systems are well defined, this indicator can also be estimated by type of livestock system: grazing system (nomadic, semi-nomadic, and sedentary), mixed system and industrial system.	(1) Number of animals by livestock type	Country Region	Annually for all livestock types Semi-annually for sheep, goats and pigs Semi-annually or quarterly for poultry	1 000 heads per livestock type
Herd structure	Number of animals broken down into categories by breed, age, sex and purpose on given reference day. This indicator should be produced for the same livestock types for which the *Number of animals* indicator is estimated. As a minimum requirement, the number of female animals of reproductive age and that are used for reproduction should be produced: cows, ewes, female goats, sows, laying hens. If the country's livestock systems are well defined, this indicator can also be estimated by type of livestock system: grazing system (nomadic, semi-nomadic, and sedentary), mixed system and industrial system.	(2) Number of animals by livestock type and category	Country Region	Annually	1 000 heads per livestock category

Concept	Definition	Common items collected	Geographical aggregation	Frequency of estimation	Measurement unit
Herd dynamics	Entries and exits of animals from the herd for a given reference period, usually 12 months. This indicator should be produced for the same livestock types for which the *Number of animals* indicator is estimated. As a minimum, the following movements have to be estimated: • number of births • number of other entries of animals: purchased, received as donation or otherwise acquired • number of animals slaughtered on the farm (including those slaughtered elsewhere but on behalf of the agricultural holding) • number of other exits of animals: sold, given or otherwise disposed The breakdown of the other exits from the farm should also be estimated as they can be used for the estimation of the animal output at farm level: • number of animals sold, of which number of animals sold for slaughter • number of animals otherwise disposed of, of which number of animals disposed for slaughter • number of dead animals, broken down by causes of death • other exits, not mentioned before (stolen or lost animals)	(8) Number of births (9) Number of other entries of animals (10) Number of animals slaughtered on the farm (11) Number of other exits of animals or Relevant technical coefficients (rates) per livestock types	Country Region	Annually	1 000 heads per entry or exit

TABLE 4.2. MEAT PRODUCTION.

Concept	Definition	Common items collected	Geographical aggregation	Frequency of estimation	Measurement unit
Meat production on hoof	Annual growth in live weight of livestock for a given reference period, usually 12 months. This indicator should be produced for the same livestock types for which the Number of animals indicator is estimated. Annual growth can be positive or negative in value. The estimation of the Meat production on hoof indicator (the total live weight of live animals) would be more precise if the number and average weights are estimates per category of livestock.	At the beginning and at the end of the reference period: (2) Number of animals by livestock type and category (18) Average live weight per category of livestock	Country Region	Annually	1 000 tonnes of live weight
Meat production from slaughtered animals	The total meat production from slaughtered animals refers to the estimation of the carcass weight of all slaughtered animals on the territory of the country, irrespective of their origin, for the given reference period, usually 12 months, including: • Slaughtering on the farm • Slaughtering in slaughterhouses • Slaughtering in other slaughtering points such as butcher shops, including communal or religious institutions that perform irregular slaughtering for festivals or other community events This indicator should be produced for the same livestock types for which the *Number of animals* indicator is estimated. The estimation of the *Meat production from slaughtered animals* indicator (the total carcass weight of slaughtered animals) would be more precise if the number and average weights are estimates per category of livestock.	(10) Number of animals slaughtered on the farm (16) Number of animals slaughtered in slaughterhouse (17) Number of animals slaughtered in other slaughtering points (19) Average carcass weight per category of livestock	Country Region	Annually Semi-annually Quarterly Monthly	1 000 heads, 1 000 tonnes of carcass weight
Gross Indigenous Product	The Gross Indigenous Product (GIP) is equal to: +Total slaughtering, regardless of origin and slaughtering point (slaughterhouse, farm or other) + Export of live animals (regardless of future utilization) – Import of live animals (regardless of future utilization) GIP is calculated per livestock type at national level for a given reference period, usually 12 months. Foreign trade data on the import and export of live animals must be obtained from the relevant customs institution.	Meat production from slaughtered animals (in terms of number of heads) Number of imported live animals Number of exported live animals	Country	Annually	1 000 heads

Concept	Definition	Common items collected	Geographical aggregation	Frequency of estimation	Measurement unit
Meat utilisation	The meat produced on the farm from animals slaughtered on the farm (including those slaughtered elsewhere but on behalf of the agricultural holdings), in carcass weight, broken down by types of utilization: • meat for home consumption of the holding household • meat sold • meat used as pay for labour (as payment in kind) • meat given to service or input providers (as payment in kind) • meat given as gift	For each type of meat: (10) Number of animals slaughtered on the farm (19) Average carcass weight per category of livestock (24) Share of meat utilization channels	Country Region	Annually	1 000 tonnes per utilization

TABLE 4.3. MILK PRODUCTION.

Concept	Definition	Common items collected	Geographical aggregation	Frequency of estimation	Measurement unit
Total milk production	Two basic concepts are used: • Gross production, which includes whole fresh milk actually milked, regardless of future use (feed, home consumption, sale, donation, etc.) and milk sucked by young animals. • Net production includes only the whole fresh milk actually milked, regardless of future use; the quantities of milk sucked by the young animals, being difficult to obtain, are excluded. The data on milk production refers to milk production, that is, the total production of whole fresh milk, excluding the milk sucked by young animals but including the milked quantities used to feed livestock for a given reference period (usually 12 months). It covers the milk production from: • cows • sheep • goats Milk from other animal species can be included, according to national priorities. If the indicator is estimated in litres, it must be recalculated in tonnes using a converting coefficient.	(3) Number of milking cows (4) Number of milking sheep (5) Number of milking goats (20) Average milk produced per year per cow (21) Average milk produced per year per ewe (22) Average milk produced per year per milking goat	Country Region	Annually	1 000 tonnes
Milk utilization	Total milk production broken down by types of utilization: • raw milk for home consumption of the holding household • raw milk used for animal feed • raw milk used for processing on the farm (to produce cheese, butter, yogurt, cream, etc.) • sold as raw milk • other use of raw milk	For each type of milk: Total milk production (23) Share of milk utilization channels	Country Region	Annually	1 000 tonnes per utilization

TABLE 4.4. EGG PRODUCTION.

Concept	Definition	Common items collected	Geographical aggregation	Frequency of estimation	Measurement unit
Egg production	Egg production covers all eggs produced during the reference period regardless of utilization (for laying or for consumption). The total production of eggs also includes eggs for hatching. As a minimum requirement, the annual egg production from laying hens has to be collected. This indicator can be expressed either in terms of the total weight of eggs or of the total number of eggs. If other laying poultry species are of interest to the country, data about their production should also be collected for national purposes.	(7) Average number of laying hens (25) Average number of eggs produced per laying hen per reference period	Country Region	Annually Semi-annually Quarterly Monthly	Tonnes or 1 000 eggs
Egg utilization	Total egg production (in tonnes or in terms of 1 000 eggs) broken down by types of utilization: • eggs for home consumption of the holding household • eggs used for hatching • eggs sold • other use of eggs	(26) Share of egg utilization channels	Country Region	Annually	Tonnes per utilization or 1 000 eggs per utilization

TABLE 4.5. FEED AVAILABILITY AND UTILIZATION.

Concept	Definition	Common items collected	Geographical aggregation	Frequency of estimation	Measurement unit
Production of main fodder crops	The fodder crops for which this indicator is produced are selected from the list of main feeds used on the farm, according to the national context and priorities. These may include: • maize grain • other grains, beans, roots, fruits etc. • maize silage • other silages • grass or hay This indicator measures the total quantity produced from fodder crops within the crop year. If secondary products such as maize stover, crop straws, tops and leaves are used for feed, their production should also be estimated. To estimate feed availability in the country, the data on national feed import and export must be considered.	For each crop: (27) Harvested area (28) Average yield	Country Region	Annually	Tonnes
Importance of feeding practices by type of livestock	Number of heads for each practice: • Only grazing, including scavenging: animals are fed only by pasture grazing and scavenging around crop parcels • Mainly grazing, including scavenging, with some feeding: animals are fed mainly by pasture grazing and scavenging around crop parcels; some complementary feed is delivered • Mainly feeding with some grazing, including scavenging: animals are fed mainly with feed bought or made on the holding from crops, and there is also some pasture grazing and scavenging around crop parcels • Only feeding without any grazing or scavenging: animals are fed with feed bought or made on the holding from crops, and there is no pasture grazing or scavenging around crop parcels	(39) Number of heads fed per main feeding practice	Country Region	Annually	Number of heads per feeding practice

Concept	Definition	Common items collected	Geographical aggregation	Frequency of estimation	Measurement unit
Feed used on the farm per source	This indicator measures the importance of the source of feed during the reference period in question, usually 12 months. It has to be calculated per main type of feed and per livestock system. The main type of feed: • agro-industrial by products/concentrate components (including crops) • forage/roughages • swill and household waste The main sources of feed are: • produced on the holding • common pasture • purchased • exchanged • received for free Where data on quantities of feed used on the farm and their sources is available, the quantity and share of the feed per source should be estimated. Where the data on quantity of feed used on the farm is not available, the indicator should measure the number of holdings using predominantly the different sources of feed.	For each type of feed: (29) Feed used on the farm per livestock type and per feed type (30) Feed used on the farm per source	Country Region	Annually	Tonnes (percentage) Number of agricultural holdings
Number of agricultural holdings using supplements/additives	Number of holdings that have used supplements/additives during the reference period.	For each type of livestock: (31) Use supplements/ additives	Country Region	Annually	Number of agricultural holdings
Total grazing area	The grazing area includes area of unused agricultural area, permanent pastures and other grazing areas. It does not include the crop area used for grazing after the harvest. If important for national purposes the grazing area can be broken down per type of grazing area which may include: • on the holding • communal grazing • rented grazing • roadsides and public area grazing	(32) Total grazing area	Country Region	Annually	Ha
Stocking rate of grazing area	The number of grazing animals converted in livestock units (LU) per grazing area over a given reference period (annually, grazing season). Grazing animals include at least bovine, sheep and goats. Other grazing animals, such as buffaloes, equines, etc., can be included according to national priorities.	(32) Total grazing area (34) Number of grazing animals	Country, Region	Annually	LU/ha

Concept	Definition	Common items collected	Geographical aggregation	Frequency of estimation	Measurement unit
Quantity of feed used per feed type and per livestock type	This indicator measures the quantity of feed used in a 12-month period per livestock type fed on a particular type of feed. A list of the main types of feed per livestock type and category has to be established at national and regional levels. The feed may include: • Agro-industrial by-products/concentrate components (usually purchased) • Forages and roughages and crops residues (can be produced on the farm, purchased or otherwise acquired) • Swill/household waste • Supplements/additives Countries must establish a list of the main feeds and types of grazing area according to the national context and priorities. It may also be necessary to distinguish between purchased or otherwise acquired feed and own-production feed. If the feeding practices within a livestock species are important for national purposes, this indicator can be calculated by livestock categories (such as female sheep, sheep under one year old, other sheep).	For each type of feed of interest including grazing: (35) Number of animals that have grazed/ were fed on particular feed during the year (36) Number of days used for grazing/ for feed on particular feed (37) Daily forage intake per feed type and per livestock type	Country Region	Annually	Tonnes per type of feed per livestock type per year
Grazing per type of grazing area	This indicator measures the number of days in a 12-month period in which livestock species grazed, broken down per type of grazing area; the latter may include: • on the holding • communal grazing • rented grazing • roadsides and public area grazing	For each type of grazing of interest: (35) Number of animals that have grazed during the year (36) Number of days used for grazing	Country Region	Annually	Number of days per type of grazing per livestock type per year

TABLE 4.6. ANIMAL HEALTH.

Concept	Definition	Common items collected	Geographical aggregation	Frequency of estimation	Measurement unit
Number of agricultural holdings using veterinary services	This indicator measures the number of holdings that have used veterinary services as a total or per livestock species. As specified in the WCA 2020 (para. 8.5.24), data on the use of veterinary services may be collected in two ways. Data for the holding as a whole can be useful as an indicator of whether such services are generally available to the holding. Data for each major livestock type can help in assessing the animal health situation of each livestock type. Countries collect data in the form best suited to their needs. Veterinary services cover all professional veterinary services used to protect animal health for the livestock kept on the holding. The type of services received includes curable treatment of diseases, surgical procedures, artificial insemination, breeding, vaccination, deworming, treatment against external parasites, general advice, etc. It also includes services provided by government organizations, such as through veterinary field workers, as well as by the private sector. The application of traditional medicine methods can be included here.	(38) Use of veterinary services during the reference period	Country Region	Annually	Number of holdings
Number of deaths or disappearance per livestock species and by cause	This indicator measures the total number of heads per livestock species per cause of death or disappearance. Causes of death may be: disease, parasites, accidents, predators, drought, etc. As an option, disappearance per cause (such as strays or theft) may be also estimated, if important in the country.	(14) Number of dead animals (15) Number of other exits, not mentioned elsewhere	Country Region	Annually	Number of heads

4.2. ITEMS

In livestock statistics, the subject of these Guidelines, an item is a characteristic to be collected through surveys and administrative sources or through direct measurement. Items may include elements such as weight, height, age, input, or output for individual livestock, as well as totals or averages of these elements across a herd or flock, or even at a regional or national scale. A large majority of the items is generally collected through the observation or survey of agricultural holdings. Some items can be collected from surveys or administrative records of livestock-related industries and the administration. The items are used to calculate or estimate indicators of livestock production or productivity. As an example, the "Number of cattle" item is collected at agricultural holdings from the sample; after processing and extrapolating the results, the "Number of cattle" indicator can be estimated at country or regional level.

Items obtained from different sources may be used to calculate or estimate the same indicator. As an example, the "Number of sheep slaughtered on the farm" item is collected at the agricultural holding from the sample, while the "Number of slaughtered sheep in slaughterhouses" item and the "Average carcass weight of sheep slaughtered in slaughterhouses" item are collected from slaughterhouses and other slaughtering points. After processing and extrapolating the results, the "Meat production from slaughtered animals (sheep)" indicator can be estimated at country or regional level. The data collection process requires choosing the items to be collected and the type of data collection activity to conduct. These choices are dictated or influenced by the:

- Decisions and decision-makers to be informed;
- Scope and goal of the study, survey or collection exercise;
- Indicators being targeted;
- Analysis and disaggregation required;
- Target commodities and livestock species, and associated inputs and production and marketing systems;
- Nature of the respondent;
- Reliability of recall, and other options such as direct measurement and proxy measurement;
- Role of the respondent;
- Resources available;
- Expected level of estimate precision.

Table 4.7. lists the main items to be collected to enable estimation of the livestock production and productivity indicators established in section 4.1.

The same indicator can be calculated using different items, according to the availability and quality of the existing data. When defining the method for calculating the indicators at national level and for the data collection process, the selection of items to be collected depends on the respondents' readiness and capacity to report the requested data and the data available from other sources (and their quality).

TABLE 4.7. LIST OF MOST COMMON ITEMS NECESSARY FOR ESTIMATING LIVESTOCK PRODUCTION AND PRODUCTIVITY INDICATORS.

Item	Notes and explanations	Measurement unit	Observation unit	Reference day/ period
(1) Number of animals by livestock type	The number of animals present on the farm on the given reference day. • Includes all animals being raised by the agricultural holding on the reference day of the survey, regardless of ownership; • Includes animals raised by the holding but not present on it because being grazed or in transit on the day of enumeration; • Livestock belonging to another holding that was moved temporarily for sanitary or other reasons (sanitary cleaning, etc.) should be excluded and reported by the holding of provenance. This item is to be collected for the types of livestock for which the *Number of animals* indicator is calculated.	Number of heads	Agricultural holding	Single reference day
(2) Number of animals by livestock type and category	Classification of animals of the same type by breed, age, sex and purpose. The WCA 2020 suggests categorizing by age and purpose (milk, meat, wool, eggs, breeding, draught power) for different livestock types. As a minimum, the number of breeding animals (female animals that are kept mainly for reproduction purposes rather than for food production) should be distinguished. To be collected for the types of livestock for which the *Herd structure* indicator is calculated.	Number of heads	Agricultural holding	Single reference day
(3) Number of milking cows	Female bovine animals that have already calved. Includes milking animals present on the survey reference day that have been milked at some time during the reference period (usually 12 months).	Number of heads	Agricultural holding	Single reference day
(4) Number of milking sheep	Female sheep that have already lambed. Includes milking animals present on the reference day of the survey that have been milked at some time during the reference period (usually 12 months).	Number of heads	Agricultural holding	Single reference day
(5) Number of milking goats	Female goats that have already kidded. Includes milking animals present on the reference day of the survey that have been milked at some time during the reference period, usually 12 months.	Number of heads	Agricultural holding	Single reference day
(6) Number of breeding sows	Female pigs weighing 50 kg and more that have already been covered for the first time, and gilts not yet covered. Includes breeding sows present on the reference day of the survey.	Number of heads	Agricultural holding	Single reference day

Item	Notes and explanations	Measurement unit	Observation unit	Reference day/ period
(7) Average number of laying hens	Includes average number of hens (may not be present on the reference day of the survey) that have laid eggs at some time during the reference period, usually 12 months. This item can be broken down by breed and laying status.	Number of heads	Agricultural holding	Single reference day
(8) Number of births	To be collected for the livestock types for which the *Herd dynamics* indicator is calculated. Includes the number of animals born on the farm during the reference period, usually 12 months.	Number of heads	Agricultural holding	12 months before the single reference day
(9) Number of other entries of animals	To be collected for the livestock types for which the *Herd dynamics* indicator is calculated. Other entries refer to the number of animals purchased or other animals acquired as gifts or as payment for work. If important for the national context, the data collection for this item can be broken down by mechanism and source channel for livestock arriving on the farm, for example by: • trader • other farmer and • other source.	Number of heads	Agricultural holding	12 months before the single reference day
(10) Number of animals slaughtered on the farm	To be collected for the livestock types for which the *Herd dynamics* and *Meat production from slaughtered animals* indicators are calculated. This number refers to the animals raised on the holding that were slaughtered on the holding itself, or elsewhere but on behalf of the holding. Slaughtering on the holding of animals raised by other holdings is excluded. Live animals sold to be slaughtered in slaughterhouses or by private persons are also excluded. The data can be broken down into categories of breed, age, sex and purpose. The categories should be coherent with those defined in the (16) *Number of animals slaughtered in slaughterhouses* item.	Number of heads	Agricultural holding	12 months before the single reference day
(11) Number of other exits of animals	To be collected for the livestock types for which the *Herd dynamics* indicator is calculated. Includes the total number of live animals that are: • sold, regardless of future use • otherwise disposed of, regardless of future use • dead, regardless of the cause of death • other exits not previously mentioned, such as lost or stolen animals	Number of heads	Agricultural holding	12 months before the single reference day
(12) Number of animals sold	To be collected for the livestock types for which the *Herd dynamics* indicator is calculated. As part of the number of *other exits of animals* (11) item, this item counts the total number of live animals sold, regardless of future use. Donations, exchange and payments in kind are excluded.	Number of heads	Agricultural holding	12 months before the single reference day

Item	Notes and explanations	Measurement unit	Observation unit	Reference day/ period
(12a) of which number of animals sold for slaughter	Optional, to be collected if the respondent knows the destination of the sold animals. As part of the *number of animals* sold (12), this item counts the number of live animals sold to be slaughtered in slaughterhouses or by private persons. The data can be broken down into categories of breed, age, sex and purpose. The categories should be coherent with those defined in item (16) *Number of animals slaughtered in slaughterhouses*.	Number of heads	Agricultural holding	12 months before the single reference day
(13) Number of animals otherwise disposed of	To be collected for the livestock types for which the Herd dynamics indicator is calculated. As part of the *number of other exits of animals* (11), this item counts the total number of live animals otherwise disposed of, regardless of future use. Disposals such as donations, exchanges, payments in kind, etc. are included here. Sold, dead, lost and stolen animals are excluded.	Number of heads	Agricultural holding	12 months before the single reference day
(13a) Number of animals otherwise disposed of for slaughter	Optional, to be collected if the respondent knows the destination of sold animals. As part of the *number of animals otherwise disposed* of (13), this item counts the number of live animals otherwise disposed of to be slaughtered. The data can be broken down into categories of breed, age, sex and purpose. The categories should be coherent with those defined in item (16) *Number of animals slaughtered in slaughterhouses*.	Number of heads	Agricultural holding	12 months before the single reference day
(14) Number of dead animals	To be collected for the livestock types for which the Herd dynamics indicator is calculated. As part of the *number of other exits of animals* (11), the number of dying animals can be collected separately and broken down by causes of death.	Number of heads	Agricultural holding Veterinary agency Focus group	12 months before the single reference day
(15) Number of other exits of animals, not mentioned elsewhere	To be collected for the livestock types for which the *Herd dynamics* indicator is calculated. This item includes other disposals not mentioned in items (12), (13) and (14). Stolen or lost animals, which may constitute a significant exit in some areas, are included here.	Number of heads	Agricultural holding Focus group	12 months before the single reference day
(16) Number of animals slaughtered in slaughterhouses	To be collected at least for the following types, if significant in the country: • Bovine • Sheep • Goats • Pigs • Poultry Data can be broken down in categories of breed, age, sex and purpose. This item includes animals slaughtered in slaughterhouses on behalf of operators other than farmers.	Number of heads	Slaughterhouses	12 months before the single reference day

Item	Notes and explanations	Measurement unit	Observation unit	Reference day/ period
(17) Number of animals slaughtered in other slaughtering points	To be collected at least for the following types, if significant in the country: • Bovine • Sheep • Goats • Pigs • Poultry The data can be broken down into categories of breed, age, sex and purpose. To be calculated for the same types and categories defined in item (16) *Number of animals slaughtered in slaughterhouses*. This item includes animals slaughtered in other slaughtering points on behalf of operators other than farmers.	Number of heads	Slaughtering points	12 months before the single reference day
(18) Average live weight per category of livestock	To be calculated for the same livestock types and categories defined previously in item (2) *Number of animals by livestock type and category*	kg/head	Markets Slaughterhouses Other slaughtering points	12 months before the single reference day
(19) Average carcass weight per category of livestock	To be calculated for the same livestock types and categories defined in item (16) *Number of animals slaughtered in slaughterhouses* According to FAO, for each of the livestock species listed below, the carcass weight is the weight of the carcass after removal of the following parts: cattle, buffalo, horses, mules, asses; • The hide or skin • The head, where it joins the spine • The forefeet at the knee joint and the hind feet at the hock joint • The large blood vessels of the abdomen and thorax • The genito-urinary organs (other than the kidneys) • The offal (edible and inedible) • The tail Sheep and goats • The skin • The offal (edible and inedible) • The genito-urinary organs (other than the kidneys) • The feet Pigs • The offal (edible and inedible) • The genito-urinary organs (other than the kidneys) Small animals are preferably reported under the "ready-to-cook" concept, equal to "things + wings + breast + ribs + back".	kg/head	Markets Slaughterhouses Other slaughtering points	12 months before the single reference day
(20) Average milk produced per cow per year	Estimation of average milk production per cow per year can be done using: • farm records on milk production; • farmer estimations or recall; or • direct measurement and lactation curve. For more details on the different methods of estimating the annual milk production at farm level, see *4.3 Calculation of indicators*.	kg/milking cow	Agricultural holding or technical coefficient	12 months before the single reference day

Item	Notes and explanations	Measurement unit	Observation unit	Reference day/ period
(21) Average milk produced per ewe per year	Estimation of average milk production per ewe per year can be done using: • farm records on milk production; • farmer estimation or recall; or • direct measurement and lactation curve.	kg/ewe	Agricultural holding or technical coefficient	12 months before the single reference day
(22) Average milk produced per milking goat per year	Estimation of average milk production per female goat per year can be done using: • farm records on milk production; • farmer estimation or recall; or • direct measurement and lactation curve.	kg/milking goat	Agricultural holding or technical coefficient	12 months before the single reference day
(23) Share of milk utilization channels	For each type of milk produced in the country (cow, sheep, goat, etc.), estimation of the share of milk used for: • raw milk for home consumption of the holding household; • raw milk used for animal feed; • raw milk used for processing on the farm (to produce cheese, butter, yogurt, cream, etc.); • sold as raw milk; or • other use of raw milk.	%	Agricultural holding Technical coefficient Focus group	12 months before the single reference day
(24) Share of meat utilization channels	For each type of livestock from which meat is produced in the country (bovine, sheep, goats, pigs, poultry, etc.), estimation of the share of the meat produced on the farm (animals slaughtered on the farm) used for: • meat for home consumption of the holding household; • meat sold; • meat used as pay for labour (as payment in kind); • meat given to service or input providers (as payment in kind); or • meat given as gift.	%	Agricultural holding Technical coefficient Focus group	12 months before the single reference day
(25) Average number of eggs produced per laying hen per reference period	To be calculated per breed, if there is significant difference in the breed's productivity. It can be estimated in different ways, using: • farm records on egg production; • farmer estimation or recall; or • estimation using auxiliary variables. For more details on the different methods of estimation of annual egg production at farm level, see *4.3 Calculation of indicators.*	Number of eggs/laying hen	Agricultural holding Technical coefficient Focus group	12 months before the single reference day
(26) Share of egg utilization channels	For total production of eggs from laying hens used for: • eggs for home consumption of the holding household; • eggs used for hatching; • eggs sold; • other use of eggs.	%	Agricultural holding Technical coefficient Focus group	12 months before the single reference day

Item	Notes and explanations	Measurement unit	Observation unit	Reference day/ period
(27) Harvested area	The fodder crops for which this item has to be calculated should be drawn from the list of feed defined to calculate the *Quantity of feed used per feed type and per livestock type* indicator.	ha	Agricultural holding	Crop year
(28) Average yield	The fodder crops for which this item has to be calculated should be drawn from the list of feed defined to calculate the *Quantity of feed used per feed type and per livestock type* indicator. To be estimated for the main product (grain, root, etc.). If the secondary product (straws, leaves, etc.) is also used for feed, the average yield per ha of secondary product should also be estimated.	kg/ha	Agricultural holding	Crop year
(29) Feed used on the farm per livestock type and per feed type	This item can be collected per livestock type, if the *Number of animals and Quantity of feed used per feed type and per livestock type* indicators are calculated for such types. For each type of feed: • agro-industrial byproducts/concentrate components (including crops • forage/roughages • swill and household waste • whether used on the farm (Yes/No), the quantity used (kg) or the share (%) per livestock type.	Yes/no, kg or %	Agricultural holding Focus group	12 months before the single reference day
(30) Feed used on the farm per source	This item can be collected per livestock type, if the Number of animals and *Quantity of feed used per feed type and per livestock type* indicators are calculated for such types. For each type of feed: • agro-industrial byproducts/concentrate components (including crops) • forage/roughages • swill and household waste it is necessary to collect the quantity or share of feed used on the farm, by source, during the reference period, that has been: • produced on the holding • drawn from common pasture • purchased • exchanged • received for free	kg or %	Agricultural holding Focus group	12 months before the single reference day
(31) Use supplements/ additives	This item can be collected per livestock type, if the indicator *Number of animals* has been calculated for them. This item can also be broken down per livestock type.	Yes/no	Agricultural holding	12 months before the single reference day

<table>
<tr><th>Item</th><th>Notes and explanations</th><th>Measurement unit</th><th>Observation unit</th><th>Reference day/ period</th></tr>
<tr><td>(32)
Total grazing area</td><td>At country level, the total area of pastures includes pastures used exclusively by single agricultural holdings as well as commonly used pastures and other areas available for grazing.

If important to the country, the area of pastures can be broken down by type of grazing area; this may include:
• fenced grazing
• communal grazing
• rented grazing
• roadsides and public area grazing</td><td>ha</td><td>Administrative sources
Village</td><td>Crop year</td></tr>
<tr><td>(33)
Forage production</td><td>Estimation of pasture production per reference period, per ha of grazing area. It is used to project the stocking rates and carrying capacity for the given reference period (annually, grazing season, etc.).</td><td>kg/ha</td><td>Agricultural holding
Village
Parcel</td><td>Crop year</td></tr>
<tr><td>(34)
Number of grazing animals</td><td>This is the number of bovines, sheep and goats converted in livestock units.

There is no one uniform set of coefficients for converting livestock numbers into livestock units. As an example, the Tropical Livestock Unit (TLU) is commonly taken to be an animal having a live weight of 250 kg:

<table><tr><th>Types</th><th>TLU conversion factor</th><th>Types</th><th>TLU conversion factor</th></tr><tr><td>Camels</td><td>1.00</td><td>Horses</td><td>0.8</td></tr><tr><td>Cattle</td><td>0.7</td><td>Mules</td><td>0.7</td></tr><tr><td>Sheep</td><td>0.1</td><td>Asses</td><td>0.5</td></tr><tr><td>Goats</td><td>0.1</td><td>Pigs</td><td>0.2</td></tr><tr><td></td><td></td><td>Chickens</td><td>0.01</td></tr></table></td><td>Livestock units</td><td>Agricultural holding</td><td>Single reference day</td></tr>
<tr><td>(35)
Number of animals that have grazed/were fed on particular feed during the year</td><td>This item can be collected per livestock type, for those types for which the Number of animals and Quantity of feed used per feed type and per livestock type indicators are calculated.
For each type of main feed and for grazing, this item counts the number of bovines, sheep, goats and other livestock that have been fed on the particular feed or that have grazed on the available grazing area during the year.</td><td>Number of animals
Livestock units</td><td>Agricultural holding
Focus group</td><td>12 months before the single reference day</td></tr>
</table>

Item	Notes and explanations	Measurement unit	Observation unit	Reference day/ period
(36) Number of days used for grazing/for feed on particular feed	This item can be collected per livestock type, for those livestock types which the *Number of animals and Quantity of feed used per feed type and per livestock type* indicators are calculated. For each type of main feed and for grazing, this item counts the number of days in the year in which the animals of the agricultural holding have been fed on the particular feed or that have grazed on the available grazing area during the year.	Number of days	Agricultural holding Focus group	12 months before the single reference day
(37) Daily forage intake per feed type and per livestock type	This item can be collected per livestock type, for those livestock types for which the *Number of animals and Quantity of feed used per feed type and per livestock type* indicators are calculated. For each type of main feed and for grazing, and for each livestock type and category, this item estimates the quantity of forage used per day per head.	kg/head/day	Technical coefficient Agricultural holding	12 months before the single reference day
(38) Use of veterinary services during the reference period	This item can be collected per livestock type, for those livestock types for which the *Number of animals* indicator is calculated.	Yes/no	Agricultural holding Veterinary Agency Focus group	12 months before the single reference day
(39) Number of heads fed per main feeding practice	This is the number of heads that have been fed mainly on: • Only grazing, including scavenging: animals are fed only by pasture grazing and scavenging around crop parcels • Mainly grazing, including scavenging, with some feeding: animals are fed mainly by pasture grazing and scavenging around crop parcels; some complementary feed is delivered • Mainly feeding with some grazing, including scavenging: animals are fed mainly with feed bought or made on the holding from crops, and there is also some pasture grazing and scavenging around crop parcels • Only feeding without any grazing or scavenging: animals are fed with feed bought or made on the holding from crops, and there is no pasture grazing or scavenging around crop parcels	Number of heads	Agricultural holding Focus group	12 months before the single reference day

4.3. CALCULATION OF INDICATORS

Establishing accurately measurable and comparable livestock productivity and production indicators is essential to obtain quality livestock statistics.

The indicators discussed in these Guidelines can be derived from various items collected from one or several sources, and will often involve relatively straightforward calculations, such as the following:

- Adding the number of animals of all agricultural holdings, in the case of censuses (or extrapolating the number of animals of the agricultural holdings interviewed, in the case of sample surveys), to determine the total Number of animals (by type of livestock) at country or regional level;
- Adding the number of animals slaughtered on the farm, in slaughterhouses and at other slaughtering points and multiplying this total number of slaughtered animals by the average carcass weight, to estimate the Meat production from slaughtered animals (by type of livestock);
- Determining the total annual Egg production from traditional chicken by multiplying the number of eggs produced per clutch by the number of clutches per year;
- Calculating the Total milk production from cows in the country on an annual basis by extrapolating the total milk produced by the interviewed agricultural holdings or multiplying the average milk produced per cow per year by the number of dairy or milking cows at national level.

Based on the main indicators, other indicators may be derived according to the needs of the relevant data users, for example:

- Estimating the number of agricultural holdings breeding a given livestock type and calculating the average herd size, by dividing the total number of heads of this livestock type by the number of agricultural holdings that breed it;
- Delineating egg, meat or milk production on the basis of factors such as region, livestock system, animal breed/s, farm size, etc.

However, in some instances, the items necessary to calculate the indicators are difficult to collect directly from the respondents and must be derived from other items or indicators that are measured more easily.

For example, the cattle productivity of a herd or individual animal may be measured by considering the contribution of a number of factors. These factors include breed, age at first calving, last calving date, still and live births, calving interval, lactation length and milk production at two points in time (at calving and "yesterday"). Farmers, especially smallholders, rarely keep records or monitor these factors, while at the same time they encounter difficulties in estimating the herd's total milk production on an annual basis or the average live and carcass weight of the animals that they keep.

Regardless of whether the indicators can be obtained from straightforward calculation based on collected items or from auxiliary indicators and technical coefficients, the quality of data collection is fundamental towards obtaining reliable statistics. This section discusses the scope and the calculation of the main indicators for livestock production and productivity, considering the specificity of the various data sources and observation units. The specific issues relating to quality data collection to be considered for each indicator are presented, and examples of calculation of the indicators based on various items are given.

4.3.1. Livestock stocks

The livestock stocks cover the following three indicators: number of animals, herd structure and herd dynamics. In the interests of harmonization and coherence, it is advised to ensure that that the definitions used and scope attributed to livestock types and livestock categories be compatible with those proposed by the WCA 2020[1]. The census data is usually used to define the sampling frame for regular surveys.

It should be noted that these Guidelines stress the importance of using only one single reference day for all agricultural holdings, within one data collection process (see section 5.1.2 for more information). If this is not possible, the day of the survey can be used as a reference day. However, to obtain a quality estimate of the number of animals, the data collection period should be as short as possible and avoid periods coinciding with special events and peaks in consumption, when large numbers of animals are slaughtered (such as Eid or Christmas in some countries). These events may significantly bias the estimation of meat production.

Number of animals

- The main sources of data are censuses and sample surveys, of which agricultural or livestock sample surveys are the most suitable to obtain the indicator on a regular basis in developing countries. If well-developed and up-to-date animal registers exist, these can also be used to determine the number of livestock;
- Household surveys may also be used to produce statistics on the number of livestock kept by households. In this case, the livestock population must be completed by the estimation of the number of animals kept by non-household agricultural holdings;
- Administrative reporting of the number of livestock at an aggregated level (village, municipality) by government institutions at the local level is a common practice. It has the advantage of being easy to implement and inexpensive; however, the quality of the reported data is often poor, due to the subjectivity of the estimations, absence of a common approach and the low control of fieldwork at the local level;
- The observation unit for censuses and surveys is the agricultural holding. The household is the observation unit, if the household survey is used as a source.

Herd structure

- The herd structure refers to the total number of animals on the reference day of the survey, broken down by category according to their age, sex and purpose.

1 WCA 2020, para. 8.5.6.

BOX 4.1. EXAMPLES OF HERD STRUCTURES.

The WCA 2020 suggests groupings by age and purpose (milk, meat, wool, eggs, breeding, draught power) for different livestock types[2]:

For each livestock type:
0502 Number of animals
of which:
0503 Number of female breeding animals
0504 Number of animals: age and sex

para. 8.5.9 Data on the age of livestock data are collected in suitable age groupings, depending on the livestock type and, sometimes, the breed of the animal. Examples of age groupings are:

- Cattle, buffaloes: calf (less than 1 year); young stock (1 year or more to less than 2 years); adult cattle/buffaloes (2 years or more)
- Sheep, goats: lamb/kid (less than 1 year); adult sheep/goat (1 year or more)
- Pigs: piglet (less than 3 months); young pig (3 months to 9 months), adult pig (over 9 months)
- Horses, camels, mules/hinnies, asses: foal (less than 1 year); yearling (1 year or more to less than 2 years); young stock (2 years or more to less than 4 years); adult stock (more than 4 years)
- Poultry: young birds (for example, aged less than three weeks); adult birds
- Other animals: according to circumstances

0505 Number of animals according to purpose

para. 8.5.11 Purpose refers to the main reason for keeping the animals. This is usually straightforward for commercial farms, as specific breeds of animal are used for certain purposes. The specific purposes recorded will depend on the type of livestock and local conditions. Normally, the following main purposes are identified. Countries may wish to further develop or combine some of the categories below:

- Cattle, buffaloes: milk; meat; draught power; breeding
- Sheep, goats: milk; meat; wool; breeding
- Pigs: meat; breeding
- Horses, camels, mules/hinnies, asses: milk; meat; draught power; breeding
- Poultry: meat; eggs; breeding
- Other animals: according to circumstances

› › ›

2 See items 0504 and 0505 of the WCA 2020.

Section 4 of the AGRIS Core Module questionnaire envisages the collection of data on the number of animals according to the following categories:

Cattle:
- Dairy cows
- Other cows
- Cattle less than one year old
- Other cattle (bulls, etc.)

Poultry:
- Broilers
- Laying hens
- All other chickens
- Turkeys
- Ducks
- Geese
- Guinea fowls
- Pigeons
- Ostriches or emus
- Other poultry

Sheep:
- Dairy females
- Other females
- Sheep less than one year old
- Other sheep (rams, etc.)

Goats: no breakdown:
- Dairy females
- Other females
- Goats less than one year old
- Other goats (bucks, etc.)

Pigs:
- Piglets
- Breeding sows
- Other pigs (boars, etc.)

AGRIS also requires the collection of data on equines, buffaloes, camelids, rabbits, insects and other animals (honeybees, etc.).
The number of animals used for traction or draught purposes per type is also collected for equines, bovines, buffaloes and camelids.
Information is collected on the number of births, animals sold/given, animals purchased/received, animals slaughtered, etc., to provide information on herd dynamics (see below).
For more information, see (GSARS, 2017; chapter 4).

- The main sources of data are censuses and sample surveys. If well-developed and up-to-date animal registers exist, they can also be used to determine the number of livestock per category.
- Collecting data on the herd structure during an agricultural census is of great importance for building the frame for future sample surveys in livestock statistics. The herd structure may be used to design stratified random samples, which are generally more efficient than simple random samples.
- Household surveys may also be used to produce statistics on the structure of the herds kept by households. In this case, the livestock population must be completed with an estimation of the number of animals per category kept by non-household agricultural holdings.
- Focus groups may be used to obtain the herd structure in a more general way (using the proportional piling technique), if the individual data from farmers are difficult to obtain or considered not reliable.
- The observation unit for censuses and surveys is the agricultural holding. The household is the observation unit, if household surveys are used; if focus groups are considered, the observation unit is the group.

Herd dynamics

- Collecting data on herd dynamics enables calculation of livestock productivity rates, such as the fertility rate, the off-take rate, livestock production as part of the farm output, etc.
- The herd dynamics indicator is calculated at farm level and at national and regional levels. Additionally, if data collection is organized accordingly, herd dynamics can also be calculated by livestock system and breed.

The fertility rate is calculated as the number of births divided by the number of female reproductive animals (cows, ewes, female goats, etc.) or by their average number for a given reference period.

The off-take rate is calculated as the total number of animals slaughtered, sold or otherwise disposed of divided by the total number of the herd or the average number of the herd, for a given reference period. The rate per type of animal disposal is calculated in a similar way: for example, the slaughtering rate is calculated as the total number of animals slaughtered divided by the total number of the herd or the average number of the herd, for a given reference period.

The growth rate is calculated as the difference between the stock at the end and the stock at the beginning of the reference period, divided by the stock at the beginning.

The livestock production value is calculated as the value of the sold animals plus the value of the animals consumed on the farm, minus the value of the purchased animals. Other disposals and acquirements of livestock, such as donations, exchanges and payments in kind, are valued and included if they are significant in the individual country context.

BOX 4.2. EXAMPLES OF CALCULATIONS OF MAIN HERD DYNAMICS RATES.

The measurement of herd dynamics varies by country and even within countries, according to the components of indicators such as fertility rate, mortality rate, off-take rate, etc.

The table below illustrates an example of herd dynamics of a bovine farm:

Herd dynamics	Code	Number
Bovine stock at the beginning	A	285
of which cows	K	131
Births	B	89
Purchase	C	14
Gifts	D	13
Other entries	E	2
Deaths	F	4
Sales	G	14
Gifts	H	23
Other exits	I	14
Bovines stock at the end	J	348
of which cows	L	116

Livestock balance: stock at the end is equal to stock at the beginning, plus the entries minus the exits of animals	
j = a + (b + c + d + e) - (f + g+ h + i)	
Average number of animals: stock at the end plus stock at the beginning divided by two	
Average number of bovines = (a + j) / 2 =	317
Average number of cows = (k + l) / 2 =	124
Fertility rate: number of calves born divided by the average number of cows	
Fertility rate = b / {(k + l) / 2} =	0.72
Off-take rate: total number of animals slaughtered, sold or otherwise disposed of divided by the average number of the herd	
Off-take rate = (g + h + i) / {(a + j) / 2} =	0.16
Growth rate: difference between the stock at the end and the stock at the beginning, divided by the stock at the beginning	
Growth rate = (j - a) / a or j / a - 1 =	0.22

- The main sources of data are censuses and sample surveys. If well-developed and up-to-date animal registers exist, these can also be used to determine the number of livestock per entry and exit channel.
- Household surveys may also be used to produce statistics on the dynamics of the herds kept by households. In this case, the livestock population must be completed by the estimation of the number of entries and exits in the non-household agricultural holdings.
- Focus groups may be used to obtain the herd dynamics in a more general way (using the proportional piling technique) if the individual data from farmers are difficult to obtain or considered not reliable.
- In many countries, some of the elements of herd dynamics, such as births and deaths, are calculated on the basis of technical coefficients for the fertility and mortality rates. These coefficients should be regularly updated (at least every three years) to provide reliable estimates. Coefficients can also be obtained through regular livestock surveys, usually on a smaller subsample of observation units for which more detailed data is collected, or with ad hoc surveys using different data collection methods (see box 4.3).
- Farmer recall, which is most commonly used to collect data on the herd dynamics of small farms, may not be reliable for small stocks, pigs and poultry if the data are collected once for the entire reference period (usually, 12 months). Smaller samples of farms can be visited more often during the reference year (every month, every three months or twice a year) to collect the data on herd dynamics for these livestock types and to calculate the annual technical coefficients for productivity, which can then be applied to all small farmers.
- The observation unit for censuses and surveys is the agricultural holding. The household is the observation unit in case of household surveys; the group is the observation unit in case of focus group.

BOX 4.3. SURVEY METHODS USED TO ESTIMATE THE HERD DYNAMICS.

The different survey methods used by countries to estimate the herd dynamics ratios of tropical ruminant livestock herds are summarized by Lesnoff (2013):

- individual animal-based monitoring
- herd monitoring without individual identification of animals, and
- retrospective cross-sectional surveys.

The article supports the long-term monitoring of the herds, which would enable accounting for inter-annual variability.

This method, however, requires regular data collection, which entails higher costs. Therefore, it is difficult to implement in developing countries, where the resources for livestock statistics are often very limited. A multiple data collection exercise (four to twelve times a year) on a subsample of agricultural holdings is a cost-efficient method to provide good estimates of the herd dynamics of the entire population.

Different software applications are developed and used throughout the world, allowing the calculation of the herd dynamics ratios based on individual animal-based monitoring. Recently, CIRAD has developed the 12MO tool, which allows for calculation based on retrospective surveys (see http://livtools.cirad.fr/12mo).

Retrospective data collection is mentioned as the most cost-effective method; however, it has the disadvantage of relying on farmer recall.

Individual animal-based monitoring provides the most accurate measurements; the disadvantages are that it is very expensive and difficult to apply at national level.

Herd monitoring appears to be a compromise between retrospective data collection and individual animal-based monitoring; however, there is as yet no standardized tool for calculating the herd dynamics ratios.

4.3.2. Meat production

Live weight (total live weight and average live weight)

- The live weight of an animal is usually used to measure animal growth. The total live weight of the herd can be obtained at the farm, village, region or national level. It can be calculated as:
    - the sum of the live weights of all animals in the herd; or
    - the total number of animals multiplied by the average live weight per animal.

The estimation or measurement of the live weight of each animal of the herd is time-consuming and expensive, as well as being impossible in most cases. On the other hand, farmer estimation of such live weights are not always reliable.

A cost-efficient method to estimate the total live weight of the herd is to collect the number of heads broken down by animal categories (breed, age, sex and purpose) and the average live weight per livestock type and category.

- The main sources of data are censuses and sample surveys. However, farmer evaluations of the live weight of their animals are often not reliable and many countries no longer collect these data directly from farmers. Instead, the average live weight per livestock category is obtained from those points at which livestock is regularly and more precisely measured;
- The method of direct measurement on the farm can be used if there are insufficient organized trade and slaughtering in the country. In these cases, a sample of the farm livestock must be selected for measurement. To ensure the method's consistency, the enumerators should possess basic knowledge of sampling techniques and receive clear instructions on how to select the animals to weigh;
- Market places and slaughterhouses are points of regular weighing that can be used to obtain the average live weight per livestock category (breed, age, sex and purpose). The livestock category should be the same as or comparable to those used for calculating the herd structure. Different sampling techniques may be applied to reduce the workload and to improve the efficiency of data collection;
- The observation unit for censuses and surveys is the agricultural holding. The household is the observation unit if the household survey is used as a source. The market places and slaughterhouses are the units of observation when data on average live weight per livestock category are estimated.

Meat production on hoof (animal growth)

- Annual growth is a variable derived from the live weight at the beginning and at the end of the reference period, usually 12 months. It is also used to estimate meat production on hoof;
- At the level of individual animals, it is measured as the difference in the live weights of the animal at the end and at the beginning of the reference period. At aggregated level (farm, region, country), it is measured as the net change in the meat on hoof, that is, the change in the total live weight during the reference period. The net change at aggregate level can be negative if there has been a decrease in the total number of animals or a change in the herd structure such as to increase the share of young animals;
- Data on the number and average live weight of live animals per livestock type and, if available, per livestock category, are necessary to estimate total meat production on hoof;
- Annual animal growth, measured in tonnes, at national level is equal to the total live weight at the end of the reference period minus the total live weight at the beginning of the reference period, where the reference period is 12 months[3].

3 The animal growth rate for a given reference period is calculated as the animal growth for the reference period divided by the total live weight of the herd.

BOX 4.4. EXAMPLES OF CALCULATIONS OF ANIMAL GROWTH (MEAT PRODUCTION ON HOOF).

Example 1. The table below illustrates an example of numbers of sheep and goats and the relative live weights of a herd:

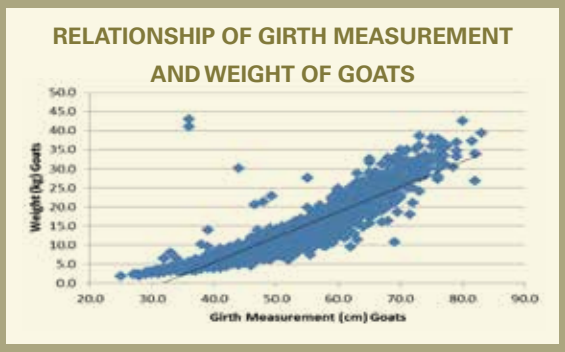
	Beginning of reference period			End of reference period		
	Total number	Average live weight (kg)	Total live weight (kg)	Total number	Average live weight (kg)	Total live weight (kg)
	a	b	c = a * b	d	e	f = d * e
Sheep	87	16.2	1 409.4	91	16.7	1 519.7
Goats	55	12.6	693	49	12.7	622.3

Animal growth: difference between the total live weight at the end and the total live weight at the beginning of the reference period.

Animal growth:	f - c
of sheep =	110.3
of goats =	-70.7

Note: animal growth may be negative if there is a decrease in the number of livestock, or a significant decrease in the average weight of the animals while their number is more or less stable.

Example 2. Estimation of live weight.
The meat production associated with the herd of live animals is measured by growth in the live weight. Livestock breeders usually do not have good estimates of the live weight of the animals that they breed and may provide unconsciously wrong data. The Global Strategy project on "Improving methods for estimating livestock production and productivity" has tested several proxy measures and compared them to the direct weighing of animals. Proxies such as body condition scores, girth measures, shoulder heights, etc. are used. Applying the proxies usually requires direct measurement by the enumerator during the face-to-face interview. It also requires a certain degree of statistical knowledge, to select a sample of animals from the herd to be measured, an ability to handle livestock and the skills necessary to measure different livestock dimensions. Furthermore, the cultural aspect must be considered, as the holders may not allow the enumerator to perform the measurement.
Data from such studies are used to construct the proxy relationships (in the example illustrated in the figure to the right, girth measure and live weight), which can then be employed as a calibrated measuring tape, a table of measurements enabling manual identification of estimated weight from the proxy measure, or as a graph from which measures can be read.



Example 3. Another approach is to use the average live weight per breed, age and sex obtained at the nearest marketplaces or slaughtering points, where the animals' live weights are often measured on a regular basis and with more precision. If such data are not available with the necessary degree of detail, a survey can be carried out at the marketplaces or slaughtering points using direct measurements of a sample of livestock.

Meat production from slaughtered animals

- The objective of collecting data on slaughtered animals is to estimate total meat production at country level.
- Meat production is estimated in terms of carcass weight on an annual basis. If the data collection exercise covers a shorter period (such as one, three or six months), total production for a 12-month reference period must be estimated.
- Meat production covers:
    - animals slaughtered on the farm;
    - animals slaughtered in slaughterhouses; and
    - animals slaughtered in other slaughtering points (markets, butcher shops, etc.).
- In practice, very often, information from different sources that cover the different types of slaughter should be compiled. In this connection, it is important to avoid double-counting, as follows:
    - Slaughtering in slaughterhouses includes all slaughtering carried out in the slaughterhouse on its own behalf. Slaughtering on a fee basis carried out by the slaughterhouse on the behalf of a third person (farm, butcher shops, etc.) must be excluded or given separately. Such slaughtering is to be included under "slaughtering on the farm" and "slaughtering in other slaughtering points", etc. as appropriate;
    - Slaughtering in other slaughtering points includes all slaughtering carried out in those points on their own behalf as well as slaughtering carried out in slaughterhouses on behalf of other slaughtering points. Usually, these are animals that were purchased by butcher shops to be slaughtered and sold as meat, or further processed and sold or distributed as food;
    - Slaughtering on the farm includes slaughtering carried out on the holding, as well as slaughtering carried out by someone else (for example, a slaughterhouse) on behalf of the holding. Sales of live animals for slaughtering are not considered slaughtering, but other disposal. Slaughtering of other people's animals on the holding should not be included. This information can be included in the farm-based livestock questionnaire.
- Data on the number and average carcass weight of slaughtered animals per livestock type and, if available, per livestock category, are necessary to estimate the total meat production from slaughtered animals.
- The main sources of data are the sample surveys, which differ according to the origin of the slaughtering:
    - in slaughterhouses, the data on the number and carcass weight of slaughtered animals per livestock type and category can be obtained directly from the administrative, veterinary or accountancy books. Meat produced from animals slaughtered in slaughterhouses on their own behalf is often included in surveys on industry;
    - Slaughtering data from other slaughtering points that are less regular in nature can be obtained through face-to-face interviews with the managers or operators, or using the existing administrative, veterinary or accountancy records;
    - Data on slaughtering on the farm can be obtained through face-to-face interviews with the holders of agricultural holdings, using the recall method. As farmer estimations of carcass weight are less reliable, it is advised to apply the average weight per animal obtained from the slaughterhouses or other slaughtering points for the closest aggregated level (such as municipality or region). Section 4 of the AGRIS Core Module contains questions on animals slaughtered on the farm and in slaughterhouses on the account of holdings, together with the average carcass weight obtained (in some countries, it is more reliable to ask for the live weight before slaughter and apply a technical coefficient to obtain the carcass weight: see http://gsars.org/en/tag/agris/).

- The method of direct measurement of the carcass weight of animals slaughtered on the farm can be used if the country's market is not sufficiently organized.
- Focus groups may be used to estimate the slaughtering data for festivals and events that involve a community, as well as slaughtering on the farm if the data provided by the farmers are considered unreliable.
- The observation unit would also differ according to the data source:
    - Slaughterhouse, if the survey is conducted on slaughtering in slaughterhouses;
    - Butcher shop, market or others, in case of surveys on slaughtering at other slaughtering points;
    - Agricultural holding, in case of slaughtering on the farm. Households are the observation unit if household surveys are used as the source. In these cases, the estimation of the total number of animals slaughtered on the farm must be completed with the animals slaughtered in agricultural holdings that belong to the non-household sector.

Gross Indigenous Product (GIP)

- The GIP is calculated at national level, usually on an annual basis, from other existing indicators. It is not necessary to collect additional data from individual agricultural holdings or other observation units.
- The following indicators are required:
    - The number and/or live weight of slaughtered animals (including animals slaughtered in slaughterhouses and other slaughtering points and animals slaughtered on the farm, regardless of origin); and
    - The number and/or live weight of exported and imported animals (data to be retrieved from the relevant customs institution).

Estimation of on-farm slaughtering

- Slaughtering on the farm as an element of the meat production from slaughtered animals is often underestimated, in particular in countries where this activity is illegal. Fearing penalties or taxation, survey respondents may underreport the number of slaughtered animals.
- Similarly to the situation in which the exact herd size is not reported, in this context, estimates from other sources may be used to cross-check or validate the results, such as focus groups, other available research on the off-take rate and its composition, veterinary records, etc. Often, data from skin markets is used to cross-check and validate slaughtering data.

4.3.3. Milk production

- The final objective of the data collection exercise is to estimate the total milk production from cows, sheep, goats, etc. at country level. Milk production from small holdings should not be underestimated and excluded from the estimation of total milk production, even if the milk produced is entirely or mainly used for own consumption on the farm.
- Obtaining data on the quantities of milk produced is not always straightforward; therefore, it is more appropriate to adopt different approaches for different types of agricultural holding:
    - Commercial holdings – data on total milk produced for the reference period or on the milk produced per milking animal can be obtained directly from administrative records, farm diaries or notes, etc.;
    - Small holdings – data on total milk production for the reference period or milk produced per milking animal is not readily available, or is not reliably estimated by the farmer. Different productivity measures can be calculated at farm level, including direct measurements of milked quantities per day. Focus groups may be used to obtain data on the seasonality of milk production (using the proportional piling technique);
    - Technical coefficients for milk productivity per milking animal can be used to estimate total milk production, provided that the number of milking animals per breed is known. These coefficients should be regularly updated (at least every three years) to provide reliable estimates. Coefficients can also be obtained through regular livestock surveys or ad hoc surveys.
- The following concepts, variables and coefficients are most frequently used:
    - "Milking animal" is an animal that is present on the reference day of the survey and that has been milked at some time during the reference period;
    - "Calving interval" is the average interval between successive calvings;
    - "Lactation curve" is a summary of the longitudinal milk yield of a milking animal from calving until drying off prior to a subsequent calving. From this amount, lactation curves can be estimated and total lactation milk yields may be predicted from incomplete data.
- The main sources of data are agricultural or livestock sample surveys.
- Household surveys may also be used to produce statistics on the milk produced by households. In these cases, the estimation of the total production of milk must be completed with the estimation of the milk production in non-household agricultural holdings.
- The observation unit for surveys is the agricultural holding. The household is the observation unit, where household surveys are used as a source.

BOX 4.5. ESTIMATION OF MILK PRODUCTION AT FARM LEVEL: EXAMPLES.

Example 1. In its Core Module questionnaire, AGRIS envisages a series of questions that enable estimation of milk production on the farm even if the agricultural holding has not conducted a systematic recording activity. The questions are related to the number of animals in lactation, the beginning and the duration of the lactation period, the period of milk production for which the respondent prefers to answer, and the quantity of milk produced for the preferred period.

Milk production is estimated as the number of answering periods multiplied by the milk quantity produced per answering period.

For example, in a farm with two cows, if the preferred answering period is one 'day', there are approximately 280 days in the cow lactation period and the quantity of milk produced daily on a typical day is 20 litres, annual milk production would be 280 days * 20 litres = 5 600 litres, or 2 800 litres per cow (see GSARS, 2017; ch. 4).

Example 2. The start of the lactation period can be used to determine the stage of lactation and to correct, if necessary, the estimation of milk production. Following calving, the cow reaches peak milk production after approximately seven weeks of lactation, after which milk production gradually falls. Another proxy to estimate milk production is to multiply daily milk production, at its peak, by 200[4].

For example, in well-managed, temperate conditions, a cow with a peak production of 20 litres per day would produce 4 000 litres per year (20 litres per day * 200). The actual values of milk production may vary significantly (from 3 percent to 12 percent), depending on:

- peak milk yield
- nutrient intake following peak yield
- body condition at calving
- other factors, such as disease status and climatic stress.

Example 3. The Global Strategy project titled "Improving methods for estimating livestock production and productivity" tested an alternative method for estimating milk production on the farm, directly measuring smallholder milk production for three days.

To calculate milk production per lactation in the two pilot countries, the project tested an alignment of milk production with curve, relative to calving date. The formula for the lactation curve is[5]:

Where YA = average of three days' production recorded in a short interval in the lactation, the whole of (a 230-day) period of milk production Y can be calculated as $Y = \Sigma_{t\text{-}A} (a^A b e^{-ca}) + \Sigma_{230\text{-}A}(a^A b e^{-ca})$.

The parameters a, b and c, generated by ongoing analysis of the Gold Standard data are:

	Parameters		
	a	b	c
Indonesia	18.07	0.0135	0.0026
United Republic of Tanzania	1.276	0.0148	0.00195

4 http://www.thecattlesite.com/articles/4248/managing-cow-lactation-cycles/.

5 Based on the incomplete gamma function developed during ongoing work. Yt = atbe-ct where Yt = milk yield at time t, a is the parameter that represents a scale factor or milk production at the beginning of lactation, b represents the slope parameter up to peak yield or a parameter determining the slope of the increasing part of the function, c is the descending slope parameter, and t is the length of time since calving or number of days after calving. The variable e is the base of the natural logarithm.

4.3.4. Egg production

- The final objective of data collection on egg production is to estimate total egg production at country level, regardless whether the eggs are used for human consumption or hatching.
- Egg production is estimated in terms of number and tonnes, on an annual basis. If the data collection covers a shorter period (such as one, three or six months), total production for a 12-month reference period must be estimated.
- Egg production covers:
    - eggs produced in small holdings; and
    - eggs produced in commercial holdings, including industry egg production.
- The main sources of data are agricultural or livestock sample surveys.
- Household surveys may also be used to produce statistics on the households' production of eggs. In this case, the estimation of the total production of eggs must be completed with the estimation of egg production in non-household agricultural holdings.
- Industry surveys are usually carried out to cover the agro-industry sector, including egg production. Due to their industrial status, large egg producers are often omitted when agricultural statistics are compiled, while they may account for more than 50 percent of total egg production in the country.
- The observation unit for surveys is the agricultural holding. The household is the observation unit when the household survey is used as a source; when agro-industry surveys are used, the observation unit is the enterprise with egg production.
- An issue to consider is the wide variability of the productivity of different breeds (such as traditional chicken and laying hens); if technical coefficients are used, they must be calculated and applied per breed.
- Apart from seasonal fluctuations and breed productivity, the breeding system significantly influences the level of productivity; therefore, it is more appropriate to adopt different approaches for different types of agricultural holdings:
    - Commercial holdings – data on the total number and weight of the eggs produced for the reference period, as well as the average number of eggs per laying hen, can be obtained directly from the administrative records, farm diaries or notes, etc.
    - Small holdings – data on total egg production for the reference period or eggs per hen are not readily available, or are not reliably estimated by the farmer. Different productivity measures can be calculated at farm level, including the total number of eggs produced over the lifetime of a hen, the hens' production cycle, the average number of eggs collected per day, the average number of clutches, the number of eggs per clutch, and clutch management (the share of eggs removed for consumption). Focus groups may be used to obtain data on the seasonality of egg production (using the proportional piling technique).

BOX 4.6. CALCULATING EGG PRODUCTION AT FARM LEVEL: EXAMPLES.

There are many ways to estimate the total production of eggs and the average production of eggs per laying hen at farm level. Three examples are indicated in this box. The first example is more suitable to industrial systems of production, the second to smallholders and semi-intensive and extensive poultry breeding systems, and the third to smallholders in the most extensive poultry-breeding systems (such as traditional chicken), in which hens do not lay eggs on a regular basis.

Example 1. The production cycle of laying hens in a farm is estimated to be 58 weeks and the number of eggs produced over a lifetime of a laying hen bred in this farm is 300. The average number of eggs per laying hen in one year (12 months) can be calculated as:

$Eggs_{hen}$ = 300 * (52 / 58) = 300 * 0.9 = 270 eggs/hen/year

The total number of eggs produced by the farm in one year can be calculated as the number of laying hens multiplied by the average number of eggs per hen: thus, if the farm has ten laying hens, Eggstot = 2 700 eggs/year.

Example 2. At the farm level, the information is obtained from the respondent. The number of laying hens is ten. On average, the farmer collects six eggs per day, with the exception of the winter months, when the average number of eggs produced per days drops to four. There are 120 days in the four winter months. The total number of eggs in one year (12 months) can be calculated as:

$Eggs_{tot}$ = (120*4 + 245*6) = (480 + 1470) = 1950 eggs/year and $Eggs_{hen}$ = 1950 / 10 = 195 eggs/hen/year

The average number of eggs produced per laying hen on the farm in one year can be calculated as the total number of eggs divided by the number of laying hens: **$Eggs_{hen}$ = 195 eggs/hen/year**.

Example 3. The Global Strategy's project titled "Improving methods for estimating livestock production and productivity" tested an alternative method for estimating egg production on the farm, which is applicable to smallholders. The following auxiliary variables must be collected either by the farmer or through a focus group:

- -number of laying hens
- average number of clutches per hen per year
- average number of eggs per clutch

If there are ten laying hens, the average number of clutches per year is three and the number of eggs per clutch is ten, the total number of eggs produced on the farm over 12 months can be calculated as:

$Eggs_{tot}$ = 10 * 3* 10 = 300 eggs/year and $Eggs_{hen}$ = 300/10 = 30 eggs/hen/year

Again, the AGRIS Core Module questionnaire proposes a series of questions aiming at calculating the egg production in the holding. (see Handbook on Agricultural Integrated survey (AGRIS, ch. 4, http://gsars.org/en/tag/agris/).

4.3.5. Feed production, availability and use

- This indicator is to be calculated for the major types of feed used for cattle, sheep, goats, pigs and poultry in the country, according to national conditions.
- There are different classifications of feed according to the criteria used. These Guidelines adopt the classification proposed by the WCA 2020 (para. 8.5.22):
    - The "Agro-industrial by-products/concentrate components (including crops)" classification includes grain (corn, wheat, barley, oat, rye, sorghum, etc.); beans (including soybean); corn gluten meal and feed; oilseeds; oilseed and cottonseed cakes; brans and middling; by-products from breweries and distillers' grains; molasses; fishmeal; cassava; banana fruit.
    - The "Forages/roughages" classification includes fresh grass or grass-legume mixture, grazed or cut and distributed; silage of grass or grass-legume mixture; hay (dry grass or grass-legume mixture); whole plant silage (maize, wheat, barley, oats, rye, etc.); crop residues (maize stoves, crop straws, sugar-cane tops, banana leaves, etc.); tree leaves.
    - "Swill/household waste" refers to organic household residues used as feed.
    - "Supplements/additives" includes vitamins, amino acids and minerals.

Feed production and availability

- At national level, feed availabilities per year are equal to the quantities produced, imported and stocked from previous years. Usually, not all quantities available are used during the year: some may be exported, lost or remain stocked at the producers, traders and farmers for the next year.
- At the farm level, the farmer may produce or purchase feed during the year and use all or part of it, the unused quantities being stocked, sold or lost.
- The production of cereals and pulses to be used for fodder, fodder crops and by-products from crops can be estimated through agricultural surveys focused on crop production.
- The source for the trade balance (export and import) is data from the customs authorities.
- Companies producing feed and by-products used for feed can be surveyed, to estimate the availabilities of agro-industrial by-products/concentrate components.
- The observation unit for agricultural surveys is the agricultural holding. The household is the observation unit where the household survey is used as a source. The agro-industry company is the observation unit for the agro-industry survey. If a focus group is used, the observation unit is the group.

Feed utilization

- The productivity of livestock depends, to a great extent, on the type and quality of feed; often, some types of animals (such as goats and poultry) in smallholder livestock systems are fed on poor-quality feed, or, as in the case of poultry, even left to scavenge.
- Feeding practices vary not only between livestock species but also within the same species, depending on the sex, age and purpose of the animal.
- These Guidelines advocate for the collection of items associated with feed use, in particular: the duration (days of feeding) of use of the feed resource, measured through the recall method. This provides an alternative to survey questions regarding the volumes used (purchased or own-production), which farmers may not be capable of estimating reliably. The AGRIS Production Methods and the Environment Rotating Module, Section 4, Part 4.5., proposes questions referring to animal feeding and use of pastures (see Handbook on Agricultural Integrated survey (GSARS, 2017; ch. 4).
- If additional data were available to provide an estimate of daily consumption rates for livestock (for example, the number or kilograms of maize stovers consumed daily by goats), these data could be used to provide an indication of annual consumption rates.
- The main sources of data are agricultural or livestock sample surveys.
- Household surveys may also be used to produce livestock statistics, including on the utilization of feed. In such cases, the data on feed utilization must be completed with the estimation of the data from non-household

agricultural holdings.

- The observation unit for agricultural surveys is the agricultural holding. The household is the observation unit, where the household survey is used as a source.
- It is anticipated that there are significant differences in the feeding practices followed by commercial holdings and smallholders. The former are expected to spend more resources on the quality and quantity of feed input, while smallholders should prioritize certain livestock species over others if feed is scarce; therefore, it is more appropriate to adopt different approaches for different types of agricultural holdings:
    - Commercial holdings – data on the type and quantities of feed used, per type of livestock and per animal, can be directly obtained from administrative records, farm diaries or notes, etc.
    - Small holdings – data on quantities of feed used can be more difficult to obtain and unreliable, as they are measured with the recall method. Therefore, the duration of use of different feed types is measured, expressed in animal-days equal to the number of feeding days per animal multiplied by the number of animals.
    - Community-level surveys or focus groups may be used to obtain the rating of pasture quality, grazing quality, frequency of use of pastures, etc. (with the proportional piling technique).
- In data collection, seasonality may affect the feed used, and some countries may also distinguish between dry and wet seasons.

BOX 4.7. ESTIMATION OF THE FORAGE USED: EXAMPLE.

The daily forage intake is calculated per forage type on a dry-matter or an as-fed basis. Forage quality affects the DM intake of an animal. The DM capacity is usually expressed as a percentage of body weight.

Technical coefficients are used to estimate DM capacity and the daily forage intake on a DM basis.

If the agricultural holding cannot provide data on the quantities of forage used, the daily forage intake can be calculated on an as-fed basis if the live weight of animals and the daily ration are known.

As an example, a cow weighing 500 kg that is not lactating would consume, from silage, approximately 2.5 percent of its weight on a DM basis, or 12.5 kg of DM per day (500 * 0.025). If the cow's daily ration includes 5 kg of silage per day on a DM basis, the daily intake of silage on an as-fed basis would be 14.3 kg, knowing that the silage consists of 65 percent humidity and 35 percent dry matter (5 / 0.35).

If we know that the total number of days the cows are fed on silage during the year is 120 and the number of cows is 50, the total quantity of silage used is 85,8 tonnes (120 days * 50 cows * 14.3 kg/head/day).

4.3.6. Animal health

Use of veterinary services

- Veterinary services are usually provided by government organizations through veterinary field workers, as well as by the private sector.
- The main sources of data are the administrative records of veterinary agencies and surveys on private veterinary enterprises.
- Agricultural surveys and censuses, as well as household surveys, may also be used.
- The quality of response, especially from small holdings, is expected to insufficient. Usually, a Yes/No question on the use of veterinary services on the "number of visits" taking place during the reference period is asked.

Causes of death or disappearance of livestock

- Enumerators' understanding the incidence and consequences of animal diseases during data collection is frequently obstructed by language and vocabulary, and poor correspondence between observed symptoms and the suggested causes of diseases and death, as well as by intervening factors such as the weather and nutrition.
- The government and private veterinaries possess the best knowledge to identify the causes of death. However, the deaths and their causes may not necessarily be regularly recorded by governmental organizations and private veterinaries. On the other hand, small livestock breeders usually do not have the knowledge required to identify the exact reason for the death.
- The main sources of data are administrative records of veterinary agencies and surveys on private veterinary enterprises.
- Agricultural surveys and censuses, as well as household surveys, may also be used. However, the quality of response, especially from small holdings, is expected to be insufficient. The AGRIS Production Methods and the Environment Rotating Module (in particular section 4, Part 4.1.) proposes questions referring to animal breeding practices and veterinary services. (see GSARS, 2017; ch. 4).
- Organizing a focus group would facilitate the full description of disease symptoms and outcomes among participants, enable discussions of cases and experience, bring in experts for comment and information, and finally hold a "vote" identifying the households whose animals have experienced the disease in question.

4.3.7. Watering of animals

- Watering practices, by type of livestock, may vary according to the period of the year (rainy or dry season), the type of livestock system (grazing nomadic, semi-nomadic or sedentary; mixed or industrial), the national context of water management, etc.
- Although they do not fall under annual livestock production and productivity statistics, the practices followed for the watering of animals are an important element to consider when analysing feeding practices and the environmental sustainability of livestock breeding.
- It is difficult to estimate the quantity of water used for watering animals; therefore, statistics usually collect other indicators to analyse the practices and issues relating to the availability of water for the purposes of livestock breeding.
- The AGRIS Production Methods and the Environment Rotating Module (see especially section 4, Part 4.6.) proposes questions referring to animal watering (see Handbook on Agricultural Integrated survey (GSARS, 2017; ch. 4). The questions relate to the main source of watering per livestock type, and consider the:
    - Main sources of water for watering animals during different seasons of the reference period;
    - Months in which problems were encountered in watering, during the reference period;
    - Main problems encountered in watering livestock during the problematic periods and the solutions implemented to provide the livestock with water; and
    - Transportation of water for the watering of animals.

- As watering practices and issues are stable, the frequency of data related to the watering of animals is considered structural data and is usually collected every three to five years. Within AGRIS, it is included in the Production Methods and the Environment Rotating Module, which should be conducted every four years.
- The reference period is a reference year corresponding to 12 months before a given reference day, or a 12-month period as fixed by the national statistical office.
- The main sources of data are sample agricultural surveys and censuses. Administrative data can be also used.

4.4. CONSTRUCTION AND APPLICATION OF A GOLD STANDARD

4.4.1. The concept of the Gold Standard

These Guidelines explore various data sources and data collection methods for the estimation of livestock production and productivity.

Periodical surveys are considered the most important tool for collecting data on livestock, livestock production and productivity from small holdings. Surveys are usually based on farmer recall or estimation, which is not always reliable. Other tools, such as administrative records, technical coefficients, expert estimates, and estimates from surveys, are also used to complete or cross-check the survey data.

Different data sources and collection tools may result in very different estimations being made for the same variable. The application of a Gold Standard is the direct measurement of items and the construction of indicators from them. Using a Gold Standard in the comparison of measurement methods ideally provides a "correct answer" against which any other answer can be evaluated. In practical terms and in the context of livestock production and productivity, this means comparing the results of direct measuring to the estimated data, based on methods such as interviews using recall, communal discussions, and various forms of survey questions or settings for asking or answering them.

The various interview question-and-answer contexts constitute, together, the methods being tested by comparison to the measurements obtained using the Gold Standard approach. The decisions relating to the design of the data collection method that will be encountered by the users of these Guidelines essentially concern whether to continue with an existing method or to adopt a new one.

The Gold Standard is conceived to be used to measure the reporting error as a difference between the estimations derived from the measured data and the existing method for data collection for the same item. The difference, expressed as a percentage, can be used to correct the reporting error, which is otherwise difficult to estimate.

The data collected to establish the Gold Standard can be used to update the technical coefficients on livestock productivity, which may replace the relevant questions to be posed to farmers.

4.4.2. Application of the Gold Standard

The Gold Standard is a direct measurement used to produce estimates of certain items or indicators (such as average live weight, average carcass weight, milk production per year per female animal, etc.) that are also collected with the conventional data collection method (in the context of livestock statistics, this is most commonly face-to-face interviewing).

To measure the difference between the two estimations efficiently, the following principles must be applied:

- the direct measurement should be carried out very soon after the data was collected with the conventional data collection method;
- both the Gold Standard and the conventional data collection should be carried out on the same agricultural holdings, and the same items and indicators should be estimated;
- Since the Gold Standard is a costly operation, it should be carried out on a subsample of the sample used for the conventional data collection process.

In the interests of cost-efficiency, the Gold Standard can be implemented every five years. Between two direct measurements, the calculated reporting error and calculated technical coefficients may be used.

Because of the high cost of Gold Standard method, it is recommended to use a subsample of the overall sample. In addition, once the households have been selected form the subsample, all species of interest must be represented; and for each species, at least one animal must be selected per category. The number of animals to choose from each category varies depending on the budget.

It is also important to use the same animals that were chosen at the beginning. However, some animals may no longer be available for monitoring (sale, death, etc.); in this case, the animal is either replaced with another animal that has the same characteristics, or, if replacement is not possible, only the data already collected is used.

4.4.3. Issues arising in the practical implementation of a Gold Standard

The application of this method is, however, subject to a number of limitations. These include a variety of constraints imposed by the costs of measurement and the associated logistics, personnel and equipment. In addition, there may be inaccuracies in measurement and problems associated with clearly defining disaggregating variables, such as the types of production system that can be examined together or separately. The practical consequence of these constraints is primarily that sample size is smaller than what is intended or may be ideal, thus weakening statistical inference. Secondarily, other practical issues of implementation also introduce weaknesses in the approach; these issues are discussed here as a guide to the design and use of Gold Standard methods.

A problem encountered in Gold Standard measurement relates to omitted variables, specifically in the disaggregation of samples. In the fieldwork associated with these Guidelines, it was established that the level of detail regarding the data on smallholder poultry egg management was insufficient to allow for an appropriate disaggregation of production systems. In particular, this referred to differing clutch management practices: the Gold Standard measured this difference as variation; however, it should have been accounted for as the operation of separate management systems.

In the case of egg production systems, a key variable was clutch length. The existing literature and local knowledge suggested a specific duration for clutches and for the periods between clutches. The Gold Standard survey design then allowed for an apparently sufficient time to observe two full clutches and the period between them. However, the observed period between clutches was found to be at least three times as long as had been previously reported, with the result that the Gold Standard study failed to capture even a single case of multiple clutches. The consequence was that the indicators calculated for the Gold Standard employed reported interclutch periods that were constructed from the alternative data collection; this reduced the "purity" of the Gold Standard test.

Cost and time pressures made it necessary to employ farmers in collecting Gold Standard data, with enumerators and supervisors playing supervisory and quality control roles. This introduces further potential for distorting the data, due to farmer bias, non-measurement or inconsistencies in measurement methods, as well as missing values. In the context of milk production methods, participating farmers played a role in selecting the cows to be milked for measurement, thus introducing further bias.

4.4.4. Justification of a Gold Standard study

The decision on whether to embark on a Gold Standard study consists essentially in an evaluation of the relative costs and benefits. As outlined above, the costs are high, although they can be mitigated by appropriate strategies; however, these do reduce the primary benefit of the Gold Standard method, which is its purity and strength.

Other benefits associated with the Gold Standard method are the following:

- Selected livestock data specialists and stakeholders gain familiarity with detailed and formal measurement methods over a protracted period of time;
- Farmers are induced into record-keeping, on the basis of an exercise of fundamental interest to them;
- Rules of thumb and other approximations are established that will endure beyond the currency of the initial study;
- Livestock data stakeholders are mobilized around a common goal, necessitating joint effort and concerted management (particularly of costs).

4.5. COMBINING AND COMPARING DATA: SURVEYS AND GOLD STANDARD COLLECTION

Increasing agricultural productivity, including in the area of livestock, is essential for poverty reduction and economic growth in most of the developing world. The ability to reliably measure livestock productivity and understand its various determinants is crucial to making investments within the sector. The quality of any statistical measure depends on the quality of the data from which it is derived. However, data quality is often poor when national livestock statistics or indicators are generated within the constraints of very limited financial and human resources or as part of broader surveys that have little focus on livestock systems.

It is emphasized, by de Mel *et al*. (2009), that most small enterprises in developing countries do not maintain detailed written records, resulting in the collection of data based on respondent recall. Surveys relying on respondent recall inevitably introduce non-sampling errors into the data collected, and the livestock production and productivity indicators subsequently estimated. The smaller the recall interval required for respondents, the lower the recall error (Samphantharak and Townsend, 2009; p. 110). However, continual surveys that require farmers or enumerators to record data frequently may also encounter impediments. Recite fatigue may have a negative effect on data quality, if farmers are asked to reproduce the same type of information repeatedly, particularly on a daily basis. Practical considerations and a pragmatic approach must be applied in evaluating the required frequency of data collection.

Where livestock conversion coefficients are regularly updated, less data on livestock production will be required from surveys or administrative records (Pica-Ciamarra *et al*., 2014; p. 65) and the quality of livestock indicators estimated from dated technical coefficient values will increase. As a first step towards ensuring high data quality and the use of up-to-date conversion coefficients, an inventory of the conversion coefficients that are currently routinely used to generate livestock indicators must be compiled.

Experience with data collection is also an advantage, in that certain 'rules of thumb' can be applied to collection on particular indicators. Although this knowledge can provide a first quick check for issues while collecting data, such as outliers, it should not be used to assess the overall information. In many cases, the information received is compared against previous results or studies conducted in controlled environments, as the capacity for checking of the quality and accuracy of the data obtained is poor.

The use of the surveys compared to a Gold Standard provides the capacity to pre-test survey responses and collection methods with a calculable measure of accuracy. Small-scale testing also enables the training of enumerators, through the completion of a number of practice runs with a subset of the targeted sample. By applying these techniques across a limited but varied number of agricultural holdings, issues, concerns and potential improvements are identified; the latter can be implemented on a larger scale, such as a countrywide agricultural census. This feedback from this process can result in changes to and refinement of the wording or methods of the tasks to be completed and highlights how the pre-testing phase of any survey provides an opportunity to vary the methods and approaches applied and to reword ambiguous or problematic questions.

In the Global Strategy project on "Improving methods for estimating livestock production and productivity", a Gold Standard for each test was established to provide a benchmark for the results of the survey methods. Surveys were implemented in two forms: Alternative "A" (more detailed), and Existing "E" questionnaires. Both illustrated the capacity of recall-based surveys to provide much more detail on agricultural production and productivity than was previously possible through collection in the pilot countries. The Existing method represents the questionnaire currently used by the testing country, while the Alternative method is proposed as an alternative way to collect information for some of the variables included in the E questionnaire. Furthermore, in some cases, the E and A questionnaires addressed different items. A sampling strategy was designed and implemented that addressed one sample of agricultural holdings in the former test (E versus the Gold Standard) and an equivalent sample in the latter (A versus the Gold Standard). In each case, agricultural holdings were randomly assigned to either E or A, and the E and A methods were implemented by an initial survey. In the weeks following the E and A surveys, all agricultural holdings were subject to the Gold Standard measurements.

The Gold Standard data collection compared the accuracy of the two surveys, as it is the method that should provide better estimates. It was confirmed that measured data may be collected in a more targeted and cost-effective way, to illustrate the expected productivity of animals over time.

Examples of experiments comparing surveys and Gold Standard data sets are included in box 4.8, box 4.9 and box 4.10.

BOX 4.8. MILK PRODUCTION DATA COLLECTION EXPERIMENT IN THE UNITED REPUBLIC OF TANZANIA.

For milk producers, the E questionnaire elicited a response on annual milk production per cow, while the A questionnaire applied to annual production as well as production in each of four indicated months and was disaggregated by breed. The table below presents the results of the questionnaire E, showing a substantial overestimation of annual production by indigenous cows and an underestimation of production by improved cows (left column). This pattern extends to a comparison between the detailed A survey (middle column) and Gold Standard data (right column).

AVERAGE DAILY MILK PRODUCTION (LITRES), UNITED REPUBLIC OF TANZANIA, EXISTING AND ALTERNATIVE QUESTIONNAIRES AND GOLD STANDARD DATA COLLECTION

	Daily production: whole/annual lactation (E, A, GStd)			Change in daily production during lactation (A)				Change in daily production during lactation (GStd)			
	Average production per cow: last 12 months (E)	Average production per cow: whole lactation (A)	Average production per cow: whole lactation (GStd)	Average production per cow: first month of lactation	Average production per cow: second month of lactation	Average production per cow: third month of lactation	Average production per cow: after third month of lactation	Average production per cow: first month of lactation	Average production per cow: second month of lactation	Average production per cow: third month of lactation	Average production per cow: after third month of lactation
Indigenous cows	-	2.11	0.74	2.24	2.05	1.76	1.35	0.76	0.75	0.67	0.74
n*	-	67	5 219	67	65	64	65	94	310	636	4179
Improved cows	-	1.91	2.02	2.54	2.01	1.88	1.34	5.62	2.17	2.27	1.80
n*	-	28	1614	28	28	28	28	48	151	235	1 180
All cows	2.01	2.05	1.04	-	-	-	-	2.40	1.22	1.10	0.98
n*	76	95	6 833	-	-	-	-	142	461	871	5 359

* Number of respondents (A and E); number of measurements among cows observed for the study (GStd).

BOX 4.9. EGG PRODUCTION DATA COLLECTION EXPERIMENT.

The E method for egg production in the United Republic of Tanzania prompted questions on the distribution of egg production throughout the year. The A method took a different approach, based on annual clutch duration and frequency, and clutch productivity. The GStd method involved counting the eggs produced over a six-week period, and observing the clutch duration. The GStd trial did not, however, allow sufficient time for the interclutch period, and thus failed to estimate clutch frequency. The results in the table below employed the A questionnaire estimates of clutch frequency to obtain estimates of annual egg production per farm.

Leaving aside the limitation on estimates of clutch frequency, the estimate calculated using the A method was not significantly different from that of the GStd method, while the result of the E method was significantly different from that of the GStd.

EGGS PER FARM PER YEAR, WITH MODIFIED GOLD STANDARD RESULTS, UNITED REPUBLIC OF TANZANIA.

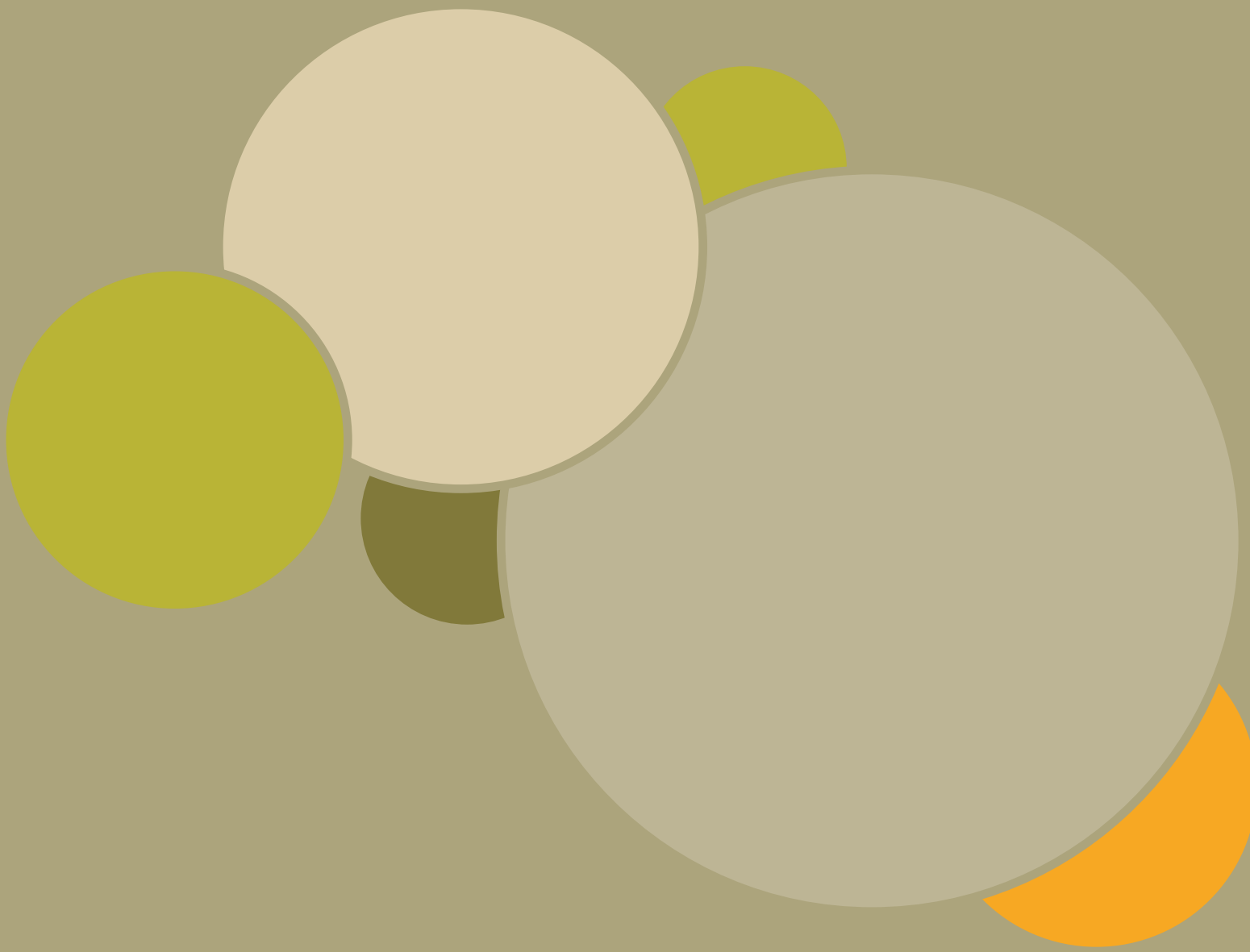
	E	A	GS
Number of eggs/farm/year	112.2	269.9	389.0
	Paired t-tests of equality of means (p values)		
E versus GStd	0.34757		
A versus GStd	0.00012		

BOX 4.10. ANIMAL LIVE WEIGHT.

The A method elicited farmer estimates of animals' live weight at three ages, and a calculated average is shown for those estimates. The GStd method entailed weighing all animals that were on the same farms and whoseages did not exceed 12 months. For both sheep and goats, the A method overestimates animal weight.

ANIMAL WEIGHTS FOR SHEEP AND GOATS UNDER 12 MONTHS OF AGE: ALTERNATIVE VS GOLD STANDARD.

	Alternative Questionnaire				Gold Stadard Data
Sheep	**3 Months Age**	**6 Months Age**	**12 Months Age**	**12 Months Age or Less**	**12 Months Age or Less**
Weight (kg)	10.2	23.6	41.4	25.1	17.7
Std Dev	5.2	12.2	14.4	10.1	8.7
Min	2.0	5.0	20.0	2.0	2.9
Max	20.0	50.0	75.0	75.0	
Goats	**3 Months Age**	**6 Months Age**	**12 Months Age**	**12 Months Age or Less**	**12 Months Age or Less**
Weight (kg)	6.9	17.1	35.1	19.7	12.5
Std Dev	3.5	9.4	16.3	9.3	7.8
Min	1.0	3.0	11.0	1.0	2.9
Max	13.0	40.0	70.0	70.0	39.3



5

Obtaining data

5.1. OPERATIONAL ISSUES ARISING IN THE IMPLEMENTATION OF LIVESTOCK SURVEYS

5.1.1. Statistical units and coverage of livestock surveys

The statistical unit of agricultural surveys is the agricultural holding. The definition used for the agricultural holding should be harmonized with the definition proposed by the WCA 2020 (WCA 2020, para. 6.2).

> *"An agricultural holding is an economic unit of agricultural production under single management comprising all livestock kept and all land used wholly or partly for agricultural production purposes, without regard to title, legal form or size. Single management may be exercised by an individual or household, jointly by two or more individuals or households, by a clan or tribe, or by a juridical person such as a corporation, cooperative or government agency. The holding's land may consist of one or more parcels, located in one or more separate areas or in one or more territorial or administrative divisions, providing the parcels share the same production means, such as labour, farm buildings, machinery or draught animals."*

The statistical unit of household surveys is the household that engages in agricultural activities. By conception, such surveys exclude the holdings that belong to legal entities. There is a high risk that such household surveys will exclude, omit or fail to represent households that keep livestock under a nomadic or semi-nomadic system. This type of livestock system usually requires a specific survey that uses different statistical methods (see GSARS, 2016).

During data collection, the units for which data is recorded are the observation unit. In other words, these are the entities upon which information is received and statistics are compiled.

Surveys usually collect general data on the statistical units, such as the location of the holding, the legal status of the holder, the age and sex of holders who are physical persons, the type of livestock system practiced, etc. As far as livestock is concerned, the *scope of the surveys* includes estimates of the number and structure of the herd per livestock type, and livestock production (meat, milk, eggs, wool, honey, etc.). These surveys may also collect data on the type and importance of animal diseases, the type and quantities of feed used, the grazing area used, farm buildings, labour input, etc.

The surveys should cover the entire country. If some areas are excluded from the survey, the livestock data concerning it must be estimated and added to the survey results. The surveys should cover the entire population of the livestock type. In practice, many countries apply a cut-off threshold, which excludes very small units from the coverage (for example, in the European Union, the Member States' regular sample surveys must cover at least 95 percent of the entire population of the species, as determined in the last farm structure survey[1]). The livestock types to be covered by the periodic surveys depend on the importance of the species within the country.

The respondents are the businesses, authorities, individual persons, etc. from whom data and associated information are collected for use in compiling statistics. Within a data collection process, the respondent is the person that answers the questions during the interview. Often, in farms run by households, agricultural tasks are assigned to different members of the family, such that a single person cannot answer all of the questions in the questionnaire.

Therefore, in the agricultural module of the Tanzanian LSMS survey, questions were not administered to only one person, such as the household head. Rather, they were addressed to multiple respondents based on who was most knowledgeable about individual topicsGiven that factors such as gender and position within the household affect the role played in the production of livestock, and that these factors often vary according to a country's culture, religion and other socioeconomic variables, this technique will improve the accuracy of the data collected and could also be applied to other surveys in the pilot countries to improve data quality overall.

5.1.2. Reference day and period, timing of survey and frequency

There are three main notions related to time in livestock statistics, each of which are crucial to data quality.

The *reference day* refers to the point of time when the number of livestock is recorded. The best practice is to use one same reference day for all agricultural holdings in a single data collection process, rather than the date of the interview, which may lead to the duplication or omission of animals. Seasonal peaks in production or consumption, as well as transhumance, must be considered when setting the reference day, as these events may significantly influence the recorded number of livestock. If it is not possible to use the same reference day, the day of the survey should be used as the reference day. In both cases, the period of data collection should be as short as possible, to obtain reliable estimates of the number of animals. Related to the reference day is the *reference period*, which covers a certain period of time before the reference date and is usually used to collect data on livestock production and productivity (such as the milk produced in the last 12 months, the number of eggs produced in the last four months, or the number of slaughtered animals in the last month). The same reference day and reference period should be used in regular surveys so that time series can be built.

The *timing* of the survey refers to the time selected for the fieldwork. According to best practices, the time of the survey should be as close as possible to the reference day. In practice, the data collection starts on the reference day and may last from one day to many months (as in the case of a census). It is important for the period of data collection to be short (two or three weeks), as the quality of the reported data may deteriorate significantly as the distance from the reference day increases. When establishing the timing of the survey, it is also necessary to consider the climate and the area's social and economic conditions. Periods of extreme weather conditions, cultural events or holidays and heavy agricultural work must be avoided to better ensure that holders and respondents will be available to be interviewed.

The *frequency of the survey* refers to how often a regular survey is conducted. It may have a single collection period

1 Regulation (EC) No 1165/2008 of the European Parliament and of the Council of 19 November 2008 concerning livestock and meat statistics and repealing Council Directives 93/23/EEC, 93/24/EEC and 93/25/EEC.

or repeated collections at set intervals. The frequency depends on the seasonality of production, the breeding cycles of the livestock, the importance of the data provided, the main user needs and the human and financial capacity of the statistical offices.

In developing countries, where funds for livestock survey may be limited, an annual survey would already be considered a good option. Because such a survey would most likely have multiple purposes, its timing cannot be determined only in consideration of changes in a particular livestock. To capture the seasonality of transactions, the respondent farmer should be asked to recall the transactions by month or season.

If resources are available and the surveys can be done by type of livestock, then the appropriate frequency of the survey may be determined. An annual survey is generally considered sufficient to capture changes to cattle herds on-farm, such as the number of births, deaths, sales and purchases. More frequent data collection is required to capture changes in poultry and egg production or pig fattening and slaughtering, such as a quarterly or even monthly basis.

Surveys relying on respondent farmer recall inevitably result in measurement errors in the data collected, and the livestock production and productivity indicators subsequently estimated. The smaller the recall interval required for respondent farmers, the lower the recall error (Samphantharak and Townsend, 2009; p. 110). However, continual surveys that require farmers or enumerators to record data frequently may likewise be impossible, because as the respondent farmer burden increases, data quality may decrease. Practical considerations and a pragmatic approach must be applied in evaluating the required frequency and timing of data collection.

5.1.3. Quality of reporting of the herd size

For cultural or tax-related reasons, many livestock breeders and, especially, pastoralists, all over the world, are reluctant to provide their exact herd size. Furthermore, often the herd kept by one agricultural holding may in fact contain animals that belong to another owner.

To avoid the duplication or omission of animals, the data should be collected considering the animals managed by the agricultural holding, that is, those present on the farm or grazing under the responsibility of the holding, regardless of the ownership of the animals (WCA 2020, para. 8.5.6).

Livestock belonging to another holding that has been moved temporarily for sanitary or other reasons (sanitary cleaning, etc.) should be reported by the other holding (WCA 2020, para. 8.5.6).

A combination of estimates from different sources may be used to obtain more precise information on herd size and cross-check the results of the data collection:

- Direct interview with the holder on herd composition (size, breeds, age, sex, destination), by declaration;
- Direct enumeration by the enumerators;
- Veterinary or administrative records, where available, on the number of vaccinations, births, deaths, diseases, slaughtered animals, etc.;
- Interview with the village heads or focus group with a small group of holders who usually have good knowledge on herd size in their community;
- Previous studies and research estimates on the structure of herds, and fertility and mortality rates per breed and location.

As a cost-effective approach, the surveys can use the direct interview method on the entire sample and direct enumeration on a subsample, to correct the declaration bias.

The estimates obtained from different sources may be very close; however, they may also differ dramatically. The relevant statistical office must examine the reliability of the sources before the actual data collection exercise and provide the field officers (enumerators) with clear instructions on how to proceed during the interviews.

5.1.4. Point of survey

The point of survey refers to the location at which the data collection takes place. In the case of livestock surveys, the best point of survey would be the location of the herd, as this would enable direct observation and measurement from the enumerator if needed. In the case of face-to-face interviews, the point of survey also depends on the location of the holder, who usually is also the respondent. In addition, the point of survey depends on the livestock system practiced by the holding.

In the case of nomadic livestock system, particular care should be taken when selecting the survey points, as the holdings within this system do not practice regular crop cultivation, do not have a fixed farm location, and their holders do not have a permanent residence. The problems relating to the enumeration of nomadic and semi-nomadic herds, as well as possible solutions, are discussed in detail in GSARS (2016). This comprehensive document lists the main enumeration points that may be used to survey nomadic herds, such as watering points, stock routes, dip tanks and vaccination posts, specific enumeration posts established for the survey, and livestock markets.

Holdings practicing a semi-nomadic (transhumant) system usually possess a permanent residence (if only for certain times during the year), where they cultivate crops for food. Such holdings move their herds seasonally to assure sufficient feed and water supplies. The point of survey could also be the holder residence, if this is harmonized with the timing of the survey, which must fall within the period when livestock is not moved on transhumance. During this time, the holder may be found at the permanent residence and the herd can be enumerated. If the point and timing of the survey are not harmonized, there is a high risk that livestock on transhumance will be omitted from the enumeration.

Holdings in mixed system are sedentary, as they have cropping activities that are more or less fixed to certain land parcels. Holdings practicing this system may be very small or very large; however, the holder or the manager is expected to be found on the farm location throughout the year. Usually, the location of a holding is defined as the place where all or most of the agricultural production occurs – where administrative or farm buildings and agricultural machinery are located or, if there is no administrative or farm building, where the majority of the land is located (WCA 2020, para. 8.1.2). The point of survey would be the farm location or the holder's address.

In the sedentary pastoral livestock system, the holder has a permanent residence, which may or may not be close to the location of the herd. In this ranching type of system, large herds are grazed on large areas. As the WCA 2020 suggests, holdings that practice this system are usually large corporations or government holdings that belong to the non-household sector. These holdings may be expected to have detailed records on herd dynamics, production and productivity, that can be used for data collection.

The majority of the holdings that practice the industrial livestock system are corporations, governmental holdings or market-oriented agricultural households. These holdings have large herds of, often, a single species, and a large part of the animal feed is produced off-farm. Because they are profit-oriented, these too may be expected to have detailed records on herd dynamics, production and productivity, that can be used for data collection.

In the last two systems, the holder or manager of the agricultural holding may not know the full details of the structure, dynamics and production rates of the herd. However, the holder or the manager should be asked to nominate the respondent and the exact point of the survey. In this case, the point of survey could be the office of the holding where the animal records are kept.

5.2. DATA COLLECTION SPECIFICS, ACCORDING TO LOCAL AND ENTITY SPECIFICITIES

In countries where the population of livestock holdings is divided into two subpopulations: (i) holdings in the non-household sector (commercial holdings) and (ii) holdings in the household sector (holdings run by households or physical persons). The different scales and availabilities of information on these two types of farm requires the use of different data sources and data collection approaches, or, more simply, two different surveys to collect those items necessary to estimate the livestock numbers and production of these two subpopulations.

Although different data collection approaches are discussed below for the two types of farms, it is important that they be harmonized in terms of concepts and definitions, reference day and period, lists of items to be collected and indicators to be obtained, ensure that complete and reliable estimates for the entire livestock population are produced.

5.2.1. Holdings in the non-household sector (commercial holdings)

These holdings usually keep large herds, have permanent employees, and produce only for the market. In many countries, these holdings are registered in a business register, pay taxes and are due to report to the statistical office or another institution on a regular basis. They keep detailed records on the numbers and dynamics of the herds, the quantities of production, the quantities and values of sales, etc. Commercial farms belong to the non-household sector and, according to national legislation, may be registered as legal units and their holder thus be a legal person.

In developed countries and, more rarely, in developing countries, private holdings whose holder is a physical person behave as enterprises and may also be considered as holdings from the non-household sector. They are specialized medium or large farms that produce mainly for the market and may have paid permanent employees who are not members of the holder's family. Very often, these holdings also keep detailed records on the numbers and dynamics of the herds, the quantities of production, the quantities and values of sales, etc.

In developing countries, the commercial holdings are usually small in number; however, they may produce a significant proportion of agricultural production. They are often subject to a separate data collection activity, such as an establishment or enterprise census or survey. Data collection regarding commercial holdings differs from data collection regarding small holdings belonging to the household sector. In terms of data sources, existing administrative records and farm records must be examined, to decide whether they can be used for statistical purposes. In terms of data collection, the design of the questionnaire and the type of questions should be adapted to the fact that commercial holdings can extract, directly from their records, information on the number, structure and dynamics of livestock, total production of milk, wool and eggs, the number and weight of slaughtered or sold animals for the reference period, the quantity of feed used, etc. Furthermore, regular data collection activities by post may be held. These holdings are often surveyed exhaustively.

BOX 5.1. FINDINGS FROM THE GS PROJECT TITLED "IMPROVING METHODS FOR ESTIMATING LIVESTOCK PRODUCTION AND PRODUCTIVITY".

Commercial livestock producers are generally thought to maintain livestock records, while records of sales may certainly be available from commercial buyers of their products – particularly milk and animals for slaughter.

The surveys may be based on a blend of interviews and livestock records. This approach is followed where a well-established commercial sector having known characteristics is in place.

5.2.2. Holdings in the household sector (small holdings)

Most of these farms do not keep records of their livestock and cropping activities; thus, usually, questions such as "What is the total milk production on the farm for the last 12 months?" are difficult to answer directly. Sets of questions are used instead, so that the auxiliary data collected directly from the respondent enables calculation of the necessary indicators. To collect the information, it may be necessary to visit the farm more than once.

Direct face-to-face interviews appear to be the most commonly used method in the developing world, where the majority of livestock are held by a large number of smallholders (World Bank, 2012). However, direct interview techniques are beset by a range of limitations that may reduce the quality of the data being collected, including heavy reliance on farmer memory and/or record-keeping, which may vary between farmers in terms of accuracy and reliability. Smallholders are less likely to keep detailed production records, and may not consider livestock production factors to be important in sustaining and improving the profitability of their operation. A related issue is accidental or deliberate respondent over- or underestimation of measurements, due to insufficient knowledge of how to estimate particular characteristics (such as livestock weight), or a desire to put a positive spin on productivity.

To overcome the limitations of direct interview, respondent answers may be supported by direct measurement from the enumerator, focus groups or technical coefficients and data from administrative reports and records.

Direct measurement is a costly operation that requires well-trained enumerators. When combined with a sample survey, this technique should be applied on a subsample of holdings. The comparison between reported and measured data on the subsample will provide the correction factor to be applied to the entire sample.

Combinations of focus groups and the completion of individual questionnaires have already been tried. Baker *et al.* (2015) reported on a mixed method employed to identify constraints on productivity and income increase among small livestock holdings in the United Republic of Tanzania. Although that study did not target the improvement of livestock statistical systems, it did demonstrate the ease of using mixed survey approaches and their capacity for capturing the energy and interest of livestock stakeholders.

Countries should choose the most appropriate method according to national or regional peculiarities, also considering the necessary sample size, the length of data collection, the capacity and willingness to participate of farmers and market and slaughterhouses operators, and the costs of the operation.

The GS project titled "Improving methods for estimating livestock production and productivity" tested three data collection methods in three pilot countries: Botswana, Indonesia and the United Republic of Tanzania. The findings of the testing are summarized in box 5.2.

BOX 5.2. FINDINGS FROM THE TESTING OF DIFFERENT DATA COLLECTION METHODS.

Farmer involvement in data capture

Successful questionnaire- and measurement-based data collection activities, such as those completed during the test phase, demonstrate the potential for farmers to be involved in livestock data collection in a more for-malized and regular way – both as indirect participants (responding to questionnaires) and direct participants (being directly responsible for measurement). For data collection to be most effective, farmers must understand exactly what is asked of them, and be able to provide a logical response to the question.

Direct farmer involvement in data collection, for example in measuring animal girth or milk productivity, has the potential to introduce respondent bias through the deliberate inflation of data or the failure to understand what the data represent. To minimize these possibilities, farmers must be trained not only to carry out data collection and recording techniques correctly, but also to appreciate the importance and benefits of accurate reporting to livestock industries in their country. The enumeration team must be assured that farmers will follow the re-quired approach consistently and accurately, to ensure that data are reliable across the sample.

It will be particularly advantageous to link the benefits of data collection directly to the farm. If farmers can ob-serve the direct benefits of data collection for themselves, they are much more willing to take part in question-naires or measurement activities. Similarly, it is widely acknowledged that farmers in developing countries gen-erally do not accumulate or make use of management data information. Thus, taking part in wider data collec-tion activities highlights, for farmers, the benefits of recording data to improve their farms' productivity and prof-itability.

Link to extension

The success of livestock data collection activities may be enhanced by involving trusted extension officers, given their experience in liaising with farmers and the positive relationships they generally share. There is also a bene-fit to the extension officer, as they are provided with another opportunity to build personal relationships with farmers in their area of responsibility.

Where farmers are required to collect data, extension officers can play a vital role in delivering the necessary training in data collection and recording. Extension officers are also well placed to contact farmers on a regular basis, to check how collection activities are progressing or to visit the farm to collect data directly. Extension also has perhaps the most important role to play, disseminating the results of livestock production and productivity analysis back to farmers upon completion of the project, and explaining the main conclusions to them. This can be expected to benefit farmers, by providing them with new information to enhance their tech-niques; however, it also illustrates the direct link between participation in the research and accruing the benefits of such research. Farmers will therefore be much more likely to be willing to participate in future data collection activities.

Multiple stages and visits

Multiple visits to collect measurement data are required to allow for changes in livestock production or produc-tivity (such as weight change or change in milk productivity during lactation) to be recorded. Logistically, this means building a sample of farmers who are willing to take part directly in measurement on multiple occasions, or for enumerators to visit them to collect data multiple times.

Repeated data collection can result in farmer dissatisfaction or fatigue with the data collection approach, and a sense that it imposes a much greater burden than a single measurement or response to a survey. Where farm-ers are reluctant to take part in repeated data collection, the participant base may be boosted by offering small gifts upon completion of the final data collection activity.

5.3. SAMPLING ISSUES

As discussed in previous chapters, livestock data are often compiled from sample surveys designed on the basis of the available sampling frames. The best option is to build a Master Sampling Frame (MSF), usually using the agricultural or livestock census (for more information, see GSARS, 2015). In this case, the MSF could form the basis of the sampling frame of agricultural surveys, including livestock surveys. However, countries with fewer resources allocated to data collection are unable to conduct agricultural censuses every ten years. In these cases, the sample is designed using other approaches (the area frame, for example).

This chapter discusses the issues related to the definition of the target population and presents the main sampling designs for holdings in the household sector (small holdings) and holdings in the non-household sector (commercial holdings). The stages of survey preparation, data editing and estimation of population are discussed here.

5.3.1. Definition of target population

The target population should be aligned with the data collection objectives and will be the basis for designing the sample and questionnaire. The target population will consist of all agricultural holdings engaged in livestock-raising activities (such as raising of cattle, sheep, goats, pigs and poultry). According to the individual country context, agricultural holdings raising other species, such as camels, can be added to the target population, while agricultural holdings raising species that are not important for the country may be excluded. Some countries may establish a threshold on the number of livestock units raised by holdings or on the sales for the agricultural holdings to be included in the target population. In the Islamic Republic of Iran, for example, a population unit will be an agricultural holding with livestock unit activity and at least has two heads of small livestock (for example, sheep and goats) or at least one head of large livestock (such as cattle, camels and buffaloes); in Canada, a population unit is an active farm with sales of CAD 10 000 or more as reported in the most recent census of agriculture, and that has contributed to the total head count for each type of livestock and poultry.

The type of livestock system practiced by agricultural holdings should be considered, when seeking to develop an effective data collection strategy. As mentioned above, the WCA 2020 defines the following types:

- Grazing system
    - Nomadic or totally pastoral
    - Semi-nomadic, semi-pastoral or transhumant
    - Sedentary pastoral or ranching
- Mixed system
- Industrial system

Within each system, the holdings' sizes and levels of specialization should also be considered. A significant part of livestock farms practice sedentary livestock, either on a specialized basis or mixed with cropping systems. These farms belong to households and are usually small subsistence or semi-subsistence farms. Industrial and sedentary pastoral systems are practiced often (but not always) by large holdings belonging to the non-household sector, also referred to as commercial holdings. They are often subject to separate data collection activities. Countries apply different methods to estimate the population of nomadic and semi-nomadic herds. Usually, nomadic herds are subject to separate data collection processes, while semi-nomadic holdings may be part of the regular livestock survey process (see GSARS, 2016).

As already discussed in this chapter, the data collection methods for small holdings and commercial holdings may differ, as the respondents' reporting capacities are not the same. In countries where the number and the share of commercial farms is not particularly significant, they are usually subject to a separate survey. Therefore, commercial holdings should be included in a subpopulation for which the sampling and data collection strategy are defined separately. In countries where commercial farms contribute the large majority of the production, only commercial farms may be considered during the data collection activity.

5.3.2. Designing the sample

Considering the inherent differences in the characteristics of holdings from the non-household sector (commercial farms) compared to the mixed subsistence and livestock holdings belonging to the household sector (small holdings), the selection of commercial farms (holdings from the non-HH sector) and holdings in the household sector (small holdings) for the sample survey should be conducted separately; hence, two different sampling designs should be developed.

If nomadic and semi-nomadic pastoralists contribute substantially to the livestock population, they should also be surveyed. Because of their unique lifestyle and cultural practices, nomadic pastoralists may not be captured in the sampling frame for other farmers, and, another sampling design should thus be developed for them. The possibility of including semi-nomadic pastoralists in the livestock survey should be analysed; this could occur if the survey is planned to take place during the period when they are settled.

The following subsections present the general procedures for developing a sampling design for holdings in the non-household sector (commercial holdings) and holdings in household sector (small holdings). The survey design for nomadic (and semi-nomadic) pastoralists is discussed in GSARS (2016).

General design

Holdings in the household sector (small holdings)

Because small holdings are located in rural areas, villages or other types of settlements that collectively cover a substantial area of a country, and given the limited resources available for a livestock survey, a viable design would be multi-stage sampling that will ultimately select the farming households or livestock farm holdings to be surveyed. As multi-stage sampling involves sampling from clusters that are known to entail a higher variability of survey estimates, techniques such as stratification and the application of uniform selection probabilities capable of mitigating the effects of high design[2] should be incorporated.

2 Design effect is the ratio of the variance of the estimate under complex design to the variance of the estimate under simple random sampling (SRS). A design effect of, for example, 2 implies that the sample size for a complex design needed to achieve the same level of variance as that of SRS will be twice as much as the sample size for SRS.

Stratifying the clusters, or PSUs, that are alike with respect to the main characteristics being estimated will lower the variance of the estimate. A wide variation in the survey weights, which are the inverses of selection probabilities, could also contribute to variability in the survey estimates. To control this, the sample can be designed to achieve uniform selection probabilities. For example, in a two-stage sampling design, given the measure of size B_α for PSU α, to apply a uniform selection probability when selecting a PSUs and *b* farming households (small holdings), the PSUs can be selected using probability-proportional-to-size (PPS) sampling, while the farming households may be selected using simple random sampling (SRS) or systematic sampling. The selection equation for selecting *b* farming household β in PSU α,assuming that there will be a sample PSUs, will be:

$$P(\alpha\beta) = P(\alpha)P(\beta|\alpha) = \frac{aB_\alpha}{\sum_\alpha B_\alpha} \times \frac{b}{B_\alpha} = \frac{ab}{\sum_\alpha B_\alpha} \qquad (1)$$

To achieve uniform selection probabilities with PPS, however, further intervening steps must be done, such as combining small PSUs or deconstructing big PSUs, so that their sizes will not vary widely. The size measure can be derived from the agricultural or livestock census. In countries where there is no census, data can be obtained from the administrative reporting system. The measure can be the number of livestock-farming households in a PSU or some other related characteristic correlated to the main characteristics of interest. As a last choice, if nothing else is available, the number of households in a PSU can be used.

Holdings in the non-household sector (commercial holdings)

Because commercial holdings are not as predominant as small holdings, there is no need to apply multi-stage sampling when selecting them. To control sampling error, commercial farms can be stratified by the type and size of livestock that they maintain. Those that manage mixed livestock may be placed in a different stratum. Very large or specific holdings may fall under a take-all stratum, of which all units will be surveyed. The farms may be selected using SRS or systematic sampling.

Developing the sampling frame

Probability sample surveys provide measures of data quality and, if designed well, a cost-effective data collection approach. To conduct probability sample surveys, all population units must be given a chance of being selected. To achieve this, a comprehensive sampling frame must be developed. This task requires clear understanding of the different types of population units. If the population units differ widely in terms of characteristics and available information, then, instead of a comprehensive sampling frame, several sampling frames can be constructed.

Holdings in the household sector (small holdings)

In developing countries, subsistence and small specialized livestock farmers comprise the majority of the population units. The agricultural or livestock census is the best data source for identifying the areas where these farmers live and constructing the sampling frame from which to select the sample for the surveys. The census can also be the basis for constructing PSUs and their corresponding measures of size, the best candidate of which is the number of small holdings in the PSUs. Possible PSUs could be the enumeration areas from a previous census, a village or group of villages, or an otherwise defined settled area, depending on the appropriate cluster size. The definition of agricultural holding used in the agricultural census should be studied: if it excludes non-farming households that raise only livestock – that is, specialized livestock households that do not engage in crop production – then other sources, such as the administrative reporting system, should be used to supplement the agricultural census.

Where countries do not have a recent agricultural or livestock census, data from the administrative reporting system could be used as a basis for constructing a sampling frame of PSUs. Small livestock holdings could then be listed in selected PSUs, from which sample small holdings can be drawn.

Holdings in the non-household sector (commercial holdings)
Commercial holdings are listed in the agricultural and/or establishments census, if they are also considered businesses. In some countries, commercial holdings may be operated by households. Usually, commercial holdings belong to a specific commodity business organization (such as the Commercial Pig Farm Owners Association) and are listed in government regulatory bodies (for example, the Securities and Exchange Commission or the Bureau of Animal Industry) for licensing and monitoring purposes. Thus, these data sources can be consolidated when developing an updated sampling frame of commercial livestock producers.

Designating the domains

Survey estimates are generally needed for the country as well as for various subgroups. These subgroups could be geographic areas such as regions, provinces or socio-economic subdivisions (for example, agro-ecological zones) that are usually spread throughout the population. The sample is usually designed to provide reliable estimates for important subdivisions, or what is known as sampling domains. In most cases, geographic subdivisions are taken as sampling domains.

As the sample size will be determined at the level of sampling domains, the total sample size across domains is likely to increase as the number of domains increases. Another factor to be considered is the need for estimates of subnational government units for resource allocation and policy monitoring purposes.

Kish (1987) also classified domains into major, minor, and mini and rare domains. Major domains comprised at least one tenth of the population, minor domains comprised between one tenth and one hundredth of the population, while mini and rare domains comprised less than one hundredth of the population.

Constructing the PSU sampling frame

For surveys of small holdings, PSUs can be constructed from the agricultural or livestock censuses. The population census can be used if agricultural or livestock censuses are not available in the country. Often, in these cases, the population census collects minimum data on the agricultural activity of the households that can be used to identify the farming households. A PSU is an area consisting of clusters of farming households or small holdings with livestock. The number of farming households or farm holdings in a PSU should be large enough to allow for flexibility and efficiency in the sampling design, and its size should not be excessively variable across PSUs. That is, there should be a control in the size of the PSUs to ensure that an effective design is achieved. Moreover, PSUs should be well defined, with clear boundaries that do not change rapidly.

Usually, a PSU is a village, a hamlet or an enumeration area defined in a previous census. PSUs should be demarcated by clear boundaries and should have a corresponding measure of size. If PPS is used to choose PSUs, the distribution of their sizes must be verified, such that if a PSU has very few small holdings, it can be merged with an adjacent PSU. In the same token, a PSU may also be oversized. To illustrate using equation (1), an oversized PSU occurs when $P(\alpha) > 1$ or $aB_\alpha \Big/ \sum_\alpha B_\alpha > 1$.

Large PSUs can either be placed into a separate stratum, in which all PSUs will be selected with certainty, or can be subdivided until the PSU size is within an acceptable range. If the latter option is chosen, care must be taken when subdividing large PSUs into smaller ones, such that the boundaries of the resulting smaller PSUs remain clearly defined for easy identification. The measure of size for the resulting PSUs can also be obtained.

The agricultural or livestock censuses should be analysed at the prospective PSU level, so that the distribution of the number of small holdings raising livestock at the prospective PSU level can be obtained across relevant geographical areas (for example, region or province). The minimum, maximum, average and median numbers of small holdings per prospective PSU level will be a good guide when constructing the PSUs. Maps showing the prospective PSUs, with a clear delineation of boundaries, will also support the merging or division of prospective PSUs.

When constructing the sampling frame of PSUs, it is also necessary to decide on the areas to exclude. For example, it should be decided whether to exclude the urban areas that are expected to not have small holdings raising livestock? Moreover, a decision must be made on whether to include areas that are difficult to access or present peace and order problems.

The resulting PSU sampling frame should contain the list of all PSUs and their corresponding geographical identification details, so that they can be easily located, and potential stratification measures can be taken. These will be explained in the next subsection.

Determining sample size and sample allocation

Two approaches can be used to compute the sample size under SRS. One would be to set the level of precision for the survey such that

$$P(|\bar{y} - \bar{Y}| < e) = 1 - \alpha \qquad (2)$$

where $\bar{y}$ is the sample mean of the characteristic of interest y, e is the margin of error, and $1 - \alpha$ is the confidence level. Thus, to obtain the level of precision e, the sample size under SRS should be

$$n_{SRS} = \frac{z^2_{\alpha/2} S^2}{e^2 + \frac{z^2_{\alpha/2} S^2}{N}}, \qquad (3)$$

where $z_{\alpha/2}$ is the standard normal abscissa at $\alpha/2$, S^2 is the population variance of the characteristic of interest y and N is the population size. N and S^2 are derived from the sampling frame (Lohr, 2010). If N is large, or if it is unknown, the sample size may be approximated to

$$n_{SRS} \approx \frac{z^2_{\alpha/2} S^2}{e^2} \tag{4}$$

On the other hand, instead of setting the margin of error to a specific level, the maximum expected coefficient of variation of the sample mean $\bar{y}$ may be set such that $\mathrm{CV}(\bar{y}) \leq \delta$ and hence, $n_{SRS} > \frac{[\mathrm{CV}(y)]^2}{\delta^2}$, where $\mathrm{CV}(y)$ is the population coefficient of variation of the characteristic of interest y and may be computed from the sampling frame.

Either of these two techniques for sample size determination for commercial farms and small holdings surveys may be used. However, for the latter, because the design involves clusters, the final sample size will be determined by multiplying n_{SRS} by the design effect,

$$d^2(\bar{y}) = \frac{\mathrm{var}(\bar{y})_{complex}}{\mathrm{var}(\bar{y})_{SRS}} \tag{5}$$

For commercial farms, after the overall sample size has been determined, stratification must be introduced. This will be discussed further in the subsection on stratification. For surveys of small holdings, the optimum number of USUs (livestock smallholder households), b_{opt} must be determined per PSU

$$b_{opt} = \sqrt{\frac{C_1}{C_2}\frac{(1-\hat{\rho})}{\hat{\rho}}} \tag{6}$$

where C_1 is the cost of adding an additional PSU into the sample and C_2 is the cost of an additional interview (Kish, 1965). The intra-class correlation can be estimated from previous livestock surveys with the equation $\hat{\rho} = \frac{d^2 - 1}{b - 1}$, where d^2 is the estimated design effect and b is the number of smallholder households from previous surveys. If there are previous surveys, the intra-class correlation can be estimated from the sampling frame:

$$\rho = 1 - \frac{\bar{B}}{\bar{B} - 1}\frac{\sum_{\alpha}\sum_{\beta}\left(y_{\alpha\beta} - \bar{y}_{\alpha}\right)^2}{\sum_{\alpha}\sum_{\beta}\left(y_{\alpha\beta} - \bar{y}\right)^2},$$

$$\bar{y}_{\alpha} = \sum_{\beta} y_{\alpha\beta} \Big/ B_{\alpha} \quad \bar{y} = \sum_{\alpha}\sum_{\beta} y_{\alpha\beta} \Big/ \sum_{\alpha} B_{\alpha} \quad \bar{B} = \sum_{\alpha} B_{\alpha} \Big/ A \tag{7}$$

A is the total number of PSUs for a given domain and $y_{\alpha\beta}$ is the characteristic of interest for livestock farming household β in PSU α. C_1 and C_2 should be determined on the basis of the budget allocated to conduct similar previous surveys. C_1 covers travelling expenses and per diem allowances, including the allowance given for the gasoline expenses of those members of staff equipped with official motorcycles during enumeration and supervision. C_2, on the other hand, can be determined by dividing the daily wage of hired interviewers by the minimum daily output derived from previous surveys. The minimum daily output can also be derived from the pre-test information, if any. It must be noted that if the administration of the questionnaire requires objective or visual measurements, the minimum daily output will be lower than that of the questionnaire that only requires answers from memory recall.

The number of PSUs to be sampled will be determined after stratification, which is discussed in the next subsection, has been finalized. At the stratum level, the number of PSUs is approximately equal to the quotient of the total sample size and the optimum number of livestock-breeding households that will be sampled b_{opt}.

Stratification

To improve the precision of survey estimates, stratification can be introduced at any stage of selection. To stratify, the population units that are similar with respect to a known characteristic of interest (auxiliary data) are grouped together so that the population variance within groups is small, while the variability across groups is large. As the auxiliary data for each population unit in the sampling frame should be known, the population proportion of each stratum should also be known. That is, the population proportion $W_h = N_h / N$, where N_h is the number of population units in stratum h, should be defined for all strata.

When stratification is used, the number of samples to be allocated for each stratum can be determined using either proportional or disproportional allocation. Proportional allocation is applied such that the sample size for stratum h is $N_h = nW_h$ where n is the total sample size. Like the SRS, proportional allocation provides almost uniform selection probabilities across strata, or EPSEM (Equal Probability SElection Method). EPSEM ensures that the survey weights do not vary widely and therefore that their contribution to the loss of precision is kept to a minimum.

Examples of disproportionate allocation are equal allocations in which $n_h = n / H$, where H is the number of strata or square root allocation such that $n_h = n \dfrac{\sqrt{N_h}}{\sum_h \sqrt{N_h}}$.

When the costs of surveying are available and a budget is imposed, the sample can be allocated optimally, such that the variance of the sample mean is minimized subject to a fixed cost. The optimum allocation for stratum h is

$$n_h = n \frac{W_h S_h / \sqrt{c_h}}{\sum_{h=1}^{H} W_h S_h / \sqrt{c_h}} = n \frac{N_h S_h / \sqrt{c_h}}{\sum_{h=1}^{H} N_h S_h / \sqrt{c_h}},$$

where S_h is the population standard deviation and C_h is the unit cost of surveying in stratum h. Note that if the unit cost of surveying and the population standard deviation are uniform across all strata, the optimum allocation is reduced to proportional allocation.

The choice of allocation method depends on the survey objectives. The difference between proportional and equal allocation is substantial when the strata differ markedly in population size. If either of these allocations is used, it will perform well for its class of estimates; however, it will perform badly for the other class. For example, if only estimates at the domain level will be obtained, then proportional or optimum allocation, depending on the available data, will yield the lesser sampling error. However, if subclass comparisons or comparisons between strata are to be done (for example, the total meat production of one geographical strata compared to another), equal allocation will provide the more precise estimate.

As only one allocation can be applied in the survey design, and surveys are usually multi-purpose and require both types of estimates, a compromise allocation that is suboptimal for both classes of estimates, but that performs reasonably well for both, is often the preferred solution. The Kish allocation (Kish, 1987) offers a good compromise, in which

$$n_h = n \frac{\sqrt{H^{-2} + IW_h^2}}{\sum_h \sqrt{H^{-2} + IW_h^2}},$$

where I is the index indicating the relative importance of estimates from proportional allocation. Note that if $I = 0$, the Kish allocation becomes the equal allocation, while as I becomes large, n_h approaches the proportional allocation. The equation $I = 1$ is used to indicate the equal importance of domain-level estimation and subclass comparison.

In a commercial farm survey, the stratification measure that is usually employed is the type of livestock. Following FAO's recommended classification, these are cattle (and buffaloes), sheep, goats, pigs and poultry. Commercial farms that have different types of livestock can be placed in a different stratum. Other stratification variables may also be applied, to further improve the precision of estimates. These stratification measures could be the size of commercial farms, the type of livestock system or geographic characteristics. In Canada, for example, the survey sampling frame was split into six overlapping groups: beef, dairy, swine, broilers, egg and turkey operations. Each of the overlapping groups were stratified by region and by category of head count (large, medium and small operations).

In a survey of small holdings, the stratification measures can be geographic characteristics (such as districts or ecological zones) and/or livestock systems, or economic characteristics, such as like the number of small holdings that raise cattle or those that raise poultry. To determine which stratification measures are effective, analysis on the sampling frame, previous surveys or administrative data can be undertaken. The correlation between important characteristics (such as total meat production and total milk production) and the potential stratification measures can be obtained.

In general, stratification variables are chosen against the following criteria: (i) the stratification variable should be highly correlated with the major survey variables (for example, the total number of cattle was used as a representative); (ii) data for all PSUs should be available; and (iii) the stratification variables should be measured consistently across all PSUs.

When the strata have been finalized, the sample size determined at the domain level can be allocated to the strata, using one of the procedures described above. The choice of allocation procedure may be based on the types of analyses that will be performed, described as follows:

a. generation of reliable estimates at the domain level, including estimates of parameters of characteristics that cut across strata within domains (such as total milk production across livestock farms of various sizes); and
b. comparison of estimates between strata (for example, total milk production between small and large commercial farms).

Kish (1978) noted that allocating the sample size proportionately across strata is the best approach to address type (a); however, it is not optimum for type (b). On the other hand, allocating the sample size equally across domains is considered the best approach for (b), and not (a). Usually, if both types of analysis are important, a Kish allocation is performed.

Sample selection

Commercial farms can be selected using SRS from each stratum, with the sample size determined through the modalities described in the previous section on sample size determination. In some countries, large farms (that are within a stratum) are taken with certainty (take all). Farms in other strata may be selected with a different or an inclusion probability, as determined by the chosen sample allocation; that is, for stratum h, the selection probability will be n_h / N_h.

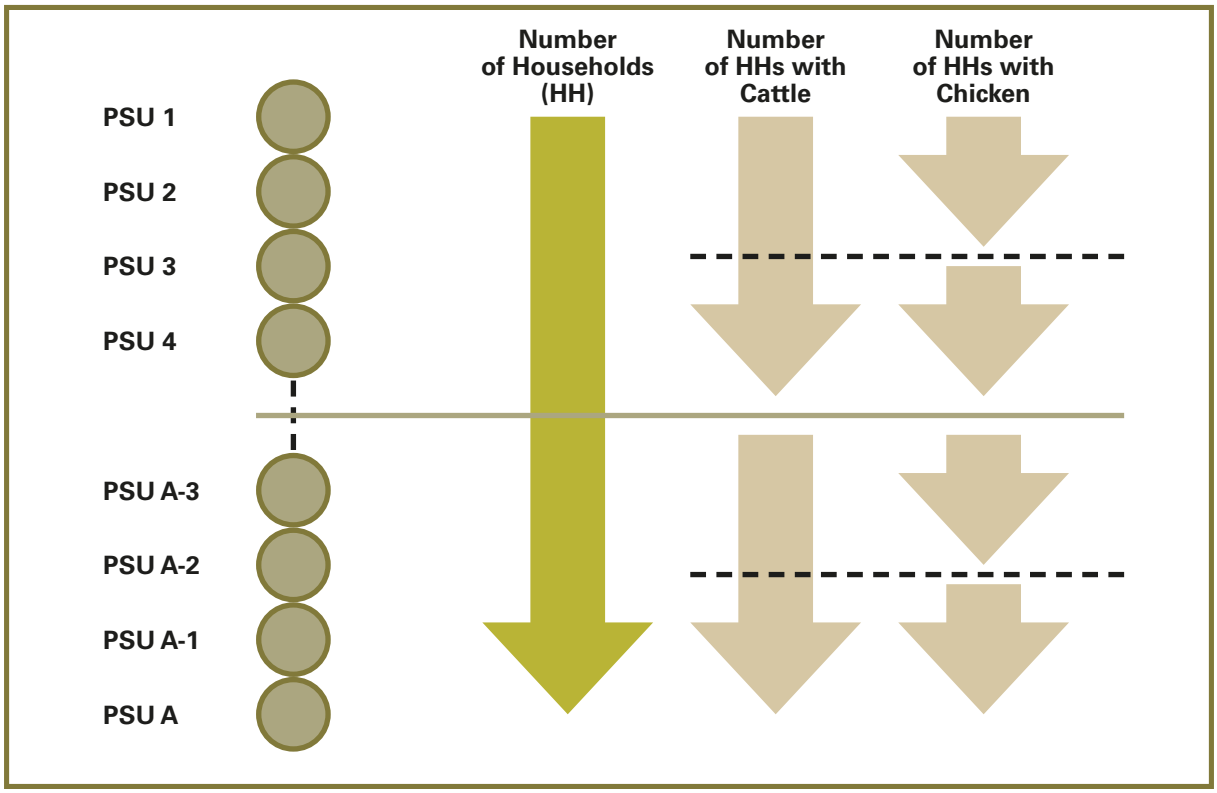
Another approach is to select the commercial farms using systematic sampling. All of the farms in a stratum can be sorted according to an auxiliary variable – one that has not been used for stratification purposes – and the farms can then be selected using a random number drawn tha between 1 and the sampling interval, which is the ratio between the total number of farms in the stratum N_h and the number of farms that should be in the sample n_h. The sampling interval is added to the random start to obtain the next farm in the sample, and so on, until the total number of farms to be sampled is achieved.

In the case of the survey of small holdings, PSUs are selected first using PPS. Many sampling designers prefer systematic PPS, to ensure a more balanced set of PSUs. In systematic PPS, PSUs can be sorted according to relevant auxiliary variable(s) before sample selection, to ensure that the PSUs selected will be representative of the population distribution of PSUs. To select the PSUs in a stratum using systematic PPS, the sampling interval will be the ratio of the total measure of size in the stratum over the number of PSUs to be selected. A random number between 1 and the computed sampling interval is then drawn. The first PSU in the sample is the first PSU whose cumulative measure of size is larger than or equal to the sampling interval. The next PSU for the sample is that whose cumulative measure of size is larger than the sampling interval plus the random number drawn, and so on.

Small holdings will then be selected within the sampled PSUs. If the sampling frame used is based on a census conducted several years before, it is prudent to first list all small holdings in the sampled PSUs before proceeding to sample selection. As the new listing is expected to render a different number for the total measure of size, for example B'_α for the PSU α, then, to maintain a uniform selection probability, the number of small holdings to be selected must be reset to $b' = b\frac{B'_\alpha}{B_\alpha}$.

Instead of applying systematic sampling in a stratum, it can be applied in a domain to choose all PSUs to be sampled under that domain. Figure 5.1. illustrates this process, which saves some analysis time while achieving results similar to those of the stratified systematic PPS. The A PSUs in a domain can be sorted by an important variable, such as the number of households, like in the example, and the median can be marked such that both halves of the set of PSUs is ordered according to the second auxiliary variable, for example the number of households with cattle. The medians on both halves can then be located, implicitly dividing the PSUs into quarters. Each quarter can then be sorted according to a third auxiliary variable, such as the number of households with poultry. The cumulative sum of the measure of size can then be computed for each PSU in the resulting ordered PSUs. The PSUs can then be selected using systematic PPS, as described above.

FIGURE 5.1. DIAGRAM OF SYSTEMATIC PPS SELECTION ON THE IMPLICITLY ORDERED PSUS OF A DOMAIN.



5.3.3. Determining the survey weights and estimation

Survey weights

Weights are important when analysing survey data, especially where sample units have different probabilities of selection. The initial step in the construction of weights is to determine the unit's base weight, which is defined as the inverse of its selection probabilities. The base weight is further adjusted to consider possible nonresponse and, potentially, to make the estimates conform to some known population totals. The final survey weight assigned to each responding unit is computed as the product of the base weight, the nonresponse adjustment, and the population weighting adjustment. The final weights should be used in all analyses to produce valid estimates of population parameters. The use of the weights in estimation is described below.

All surveys experience some degree of unit or total nonresponse in which a sampled and eligible unit fails to participate in the survey (for example, the unit may refuse to participate, or may never be at home when the interviewer calls). Adjustments are made to the base weights to compensate for nonresponse by the sampled units eligible for the survey. The adjustment inflates the base weights of "similar" responding units to compensate for each nonrespondent farmer.

The most common form of nonresponse-weighting adjustment is a weighting class adjustment. This could be used for household surveys, including surveys of small holdings raising livestock. The full sample of respondent farmers and nonrespondent farmers is divided into a number of weighting classes or cells, and nonresponse adjustment factors are computed for each cell *c* as

$$w'_c = \frac{\sum_{i \in rc} w_{di} + \sum_{j \in mc} w_{dj}}{\sum_{i \in rc} w_{di}} = \frac{\sum_{i \in sc} w_{di}}{\sum_{i \in rc} w_{di}} \qquad (8)$$

The denominator of W'_c is the sum of the weights of respondent farmers (indexed *rc*) in weighting cell *c*. The numerator gives the sum of the weights for the total eligible sample in weighting cell c (indexed *sc*), by adding together the sum of the weights for respondents (indexed *rc*) and the sum of the weights for eligible nonrespondents (indexed *mc* for missing) in cell *c*. Thus, the nonresponse weight adjustment W'_c is the inverse of the weighted response rate in cell *c*. It should be noted that the adjustment is applied with eligible units. Ineligible sampled units (such as holdings with no livestock) are excluded.

The weighting cells are created by combining PSUs with similar characteristics. The combinations are formed within the sampling strata. To form the weighting cells, care must be taken so that there will be adequate numbers of sampled units in all weighting cells. Another point to consider is that a low response rate would result in a large nonresponse adjustment, and may yield less precise survey estimates. Therefore, the prospective weighting cells should be reviewed further, to avoid this outcome when forming cells.

When the weighted sample distributions of certain characteristics of interest do not conform to known population distributions (such as the total livestock count from the census or from an alternative credible source), that is, when sample estimates of population counts generally fall short of true population counts because of noncoverage, further weighting adjustments – here termed population weighting adjustments – can be made. Population weighting adjustments could be introduced to compensate for noncoverage and to make survey estimates based on the adjusted weights estimates consistent with known population distributions. These weighting adjustments may be made within weighting cells, such as the nonresponse cells described above. In this case, the adjustments are often termed post-stratification adjustments, although there are other types of adjustments that could be made using some form of calibration method. This weighting adjustment is introduced only when a credible external source for population data is available.

The final survey weight assigned to each responding unit is computed as the product of the base weight, the nonresponse adjustment, and the population weighting adjustment, as described above. The final weights should be used in all analyses to produce valid estimates of population parameters. The use of the weights in estimation is described below.

Estimation of the population totals, means and ratios

Estimate of population total

Consider first the estimation of a population total. Let y_i and w_i denote the value of characteristic of interest y and the final weight for respondent farmer i. The notation can be applied to households or persons or any other unit of analysis. The final weight w_i can be considered as the number of population units represented by respondent farmer i; thus, Σw_i estimates the total number of units in the population, N. The survey estimate of the population total for characteristic of interest y, denoted by Y, is then simply $\hat{Y} = \Sigma w_i y_i$.

Estimate of a subclass total

The estimate $\hat{Y}$ has wide applicability. It can be used for estimating the count of the population with a given characteristic by setting $y_i = 1$, if respondent farmer i possesses the characteristic and $y_i = 0$ if the respondent does not. For example, with $y_i = 1$, if respondent farmer i is engaged in mixed farming and $y_i = 10$ otherwise, $\hat{Y}$ estimates the total number of farmers engaged in mixed farming in the population. The estimator $\hat{Y}$ can be used to estimate the total population possessing a given characteristic in a population subgroup by setting $y_i = 1$ only if respondent farmer i is in the subgroup and possesses the characteristic. Alternatively, the subgroup total can be estimated by setting $w_i = 0$ for respondent farmers not in the subgroup, or by performing the summation in $\hat{Y}$ only for respondent farmers in the subgroup, that is, $\hat{Y}_s = \Sigma_{i \in g} w_i y_i$, where g stands for subgroup g.

The extension to estimating a population mean for y, $\bar{Y} = Y / N$, is straightforward. With $\hat{Y}$ estimating the population total Y and Σw_i estimating N, $\hat{Y}$ may be estimated by $\bar{y} = \Sigma w_i y_i / \Sigma w_i$. Note that if Σw_i is not fixed, then $\bar{y}$ is not a simple weighted mean but rather a ratio mean, which is discussed below.

Estimate of a subclass mean

An example of subclass mean is the mean income of mixed small holdings, which is the ratio of the total income of mixed small holdings to the estimated total mixed small holdings.

To estimate the mean for a subgroup, define $u_i = 1$ if the farmer I belongs to the subgroup g, and 0 otherwise. Then, the mean of the characteristic y for those in subgroup g is $\bar{y}_g = \sum_{i \in s} u_i w_i y_i \Big/ \sum_{i \in s} u_i w_i$. This is an example of a ratio mean, which will be discussed below.

Estimate of a mean using ratios

In general, a population ratio of the form $R = Y / X$, where X is the population total for another characteristic of interest denoted by x, may be estimated by the ratio estimator $r = \Sigma w_i y_i / \Sigma w_i x_i$. A mean or proportion is the special case, with $x_i = 1$ for all units in the population and $y_i = 1$ if the unit i has the characteristics and 0 otherwise. For example, if the proportion of mixed small holdings will be estimated, then $y_i = 1$ if farmer I is a mixed small holding.

Suppose that the total number of animals of a specific type of livestock will be estimated. A direct estimate will be $\hat{Y} = \Sigma w_i y_i$. However, if the survey also provides additional information that is closely related with the characteristics of interest to be estimated, such as the total grazing area (x), and $\hat{X} = \Sigma w_i x_i$, then the number of animals of a specific type of livestock can be estimated by $\hat{Y}_R = \frac{\hat{Y}}{\hat{X}} X$, where X is the total grazing area from the most recent census or administrative reporting system.

With complex sample designs, sample means and proportions of the form $\bar{y}$ computed for specific subclasses are generally ratio estimators that involve the ratios of two random variables. The denominator of $\bar{y}$ is Σw_i, which is an estimate of the size of the population or a subgroup, and as such is a random variable. This feature affects the computation of sampling errors for means and proportions, as discussed below.

Variance estimation

The precision of a survey estimate depends not only on the sample size, but also on the survey's sample design. There are two main approaches to estimating the sampling errors for survey estimates: a Taylor's series or linearization approach and some form of replication approach. Both approaches involve approximations and, in particular, both generally assume that the first-stage sampling fractions are small. With this assumption, the sample design can be treated as if the PSUs were sampled with replacement, thus greatly simplifying the computations. Under the "with replacement" assumption, there is no need to explicitly consider the second and subsequent stages of sampling in variance estimation: they are automatically incorporated into the variance estimates.

The following paragraphs provide a brief introduction to variance estimation for estimates from surveys that has replicated sampling design. The Taylor Series Linearization (TSL) approach is presented here because this approach is likely to be used more often; in particular, the "with replacement" approximation will be used. With this approximation, the only aspects of sample design that feature in variance estimation are the first-stage strata, the PSUs and the survey weights. Each respondent record in the survey data file must contain information on these three variables to enable variance estimates to be computed. The survey sampling error software packages that apply the TSL approach (such as SAS, STATA, R, CENVAR, and SUDAAN) require these design variables to be part of the input.

The identification of these three design variables for the responding sample can be achieved by extending the subscript notation. In particular, let $y_{h\alpha i}$ and $w_{h\alpha i}$ denote the value of characteristic of interest y and the final weight for respondent i in PSU α in stratum h. As before, this notation can be applied equally to holdings or farms as the units of analysis.

Consider the estimation of the variance of an estimated population total. The estimate of the population total is the sum of the estimates of the totals for each of the strata: $\hat{Y} = \Sigma \hat{Y}_h$. Under the "with replacement" approximation, the variance of $\hat{Y}_h = \Sigma_\alpha \Sigma_i w_{\alpha i} y_{\alpha i}$ can be estimated by

$$\text{var}(\hat{Y}_h) = \frac{a_h}{a_h - 1} \sum_\alpha \left(y_{h\alpha} - \frac{\hat{Y}_h}{a_h} \right)^2 \qquad (9)$$

where $y_{h\alpha} = \Sigma_i w_{\alpha i} y_{\alpha i}$ is the weighted total of the survey characteristic of interest y for PSU α in stratum h and α_h is the number of sampled PSUs in that stratum. It should be noted that equation (9) involves computing the totals for each sampled PSU in the stratum and then computing the variance between these totals. All PSUs must be included in the computation of equation (9) even if they do not contribute to the population total (that is, $y_{h\alpha} = 0$).

The calculation of $\text{var}(\hat{Y}_h)$ in equation (9) cannot be performed unless at least two PSUs are sampled from the stratum. In designs where one PSU is sampled from each stratum, the collapsed strata procedure is applied. This procedure involves treating a set of strata as if they were a single stratum with several selected PSUs. The resulting variance estimate overestimates the variance of the survey estimate, to a certain degree. The overestimation is minimized if the collapsing involves pairs of strata with similar means for the survey characteristics of interest. The collapsing method employed for the full set of PSUs can pair off PSUs within an explicit stratum, placing the first two PSUs sampled from the ordered list in one collapsed stratum and the other two PSUs in the other collapsed stratum.

The extension of equation (9) to variance estimates for estimates of domain and national totals is straightforward. The estimate of a domain total is $\hat{Y}_d = \Sigma_{h \in d} \hat{Y}_h$ and, because of the independence of sampling between strata, its variance is $\Sigma_{h \in d} \text{var}(\hat{Y}_h)$. The estimate for a national total is $\hat{Y} = \Sigma_h \hat{Y}_h$ and its estimated variance is $\Sigma_h \text{var}(\hat{Y}_h)$. An estimated variance for a subclass total is given by the same formulas, and with $y_{h\alpha i} = 0$ for units that are not in the subclass.

As noted earlier, estimates of population means and proportions for the total sample or for subclasses are special cases of ratio estimators. In general, the estimated variance of a ratio estimator $r = \hat{Y} / \hat{X}$ is approximately

$$\text{var}(r) \approx \frac{1}{\hat{X}^2}[\text{var}(\hat{Y}) + r^2 \text{ var}(\hat{X}) - 2r \text{ cov}(\hat{Y}, \hat{X})] \qquad (10)$$

where $\text{cov}(\hat{Y}, \hat{X})$ is the covariance of $\hat{Y}$ and $\hat{X}$. The variances $\text{var}(\hat{Y})$ and $\text{var}(\hat{X})$ can be computed as above and $\text{cov}(\hat{Y}, \hat{X}) = \sum_h \text{cov}(\hat{Y}_h, \hat{X}_h)$ may be computed as

$$\text{cov}(\hat{Y}_h, \hat{X}_h) = \frac{a_h}{a_h - 1} \sum_\alpha \left(y_{h\alpha} - \frac{\hat{Y}_h}{a_h} \right) \left(x_{h\alpha} - \frac{\hat{X}_h}{a_h} \right) \qquad (11)$$

It must be noted, however, that equation (10) is a reasonable approximation only if $\hat{X}$ has a small coefficient of variation, such as 10 percent or less. The estimate of the variance is tolerable if $\left(\hat{X}\right) \leq 20\%$. The CV of the ratio estimate $\hat{Y}_R$ is lower than that of a direct estimate $\hat{Y}$ if there is a positive correlation between the characteristic of interest *Y* and the auxiliary variable *X*. The *CV* of $\hat{Y}_R$ will be lower than that of the *CV* of $\hat{Y}$ when the correlation coefficient ρ is $\rho > \frac{\text{CV}(x)}{2\text{CV}(y)}$ or when the *CV* of the auxiliary variable X is less than twice the product of the correlation coefficient and the *CV* of the characteristic of interest.

The formulas given here can be used to provide estimates for many of the types of estimates that are produced from agricultural surveys, including livestock. Extensions to other estimates are available in the survey sampling literature. In practice, however, the variance computations will generally be done using a survey analysis software package. This software will require the stratum, PSU, and weight to be identified for all respondents in order to perform the variance estimation calculations.

5.4. SOME ISSUES RELATED TO SURVEY PLANNING

5.4.1. Defining the data collection objectives and method

An effective data collection strategy should be developed in line with the data collection objectives and the available infrastructure and support. Hence, the data collection objectives should be established at the outset to guide the planning and implementation of the data collection effort. Major stakeholders may be consulted when setting the data collection objective.

The data collection objectives vary widely across countries, contingent on their development plans and critical issues. In general, countries would usually collect livestock inventory, production and price data and other animal-health related indicators to support the compilation of national accounts, food security monitoring, and government planning and resource allocation efforts.

It is recommended to select the source and method of data collection from the various options discussed in chapter 3 and considering the data collection objectives. There is no one best method for data collection and countries should decide to use the method or combination of methods best suited to their purposes.

5.4.2. Designing the questionnaire

The questionnaire should be designed on the basis of the data collection objectives, the major uses of the data that will be collected, and the available infrastructure and budget.

The FAO, the World Bank and the International Livestock Research Institute (ILRI) collaborated to draft three survey modules aimed at collecting comprehensive information on livestock farming systems — one short version, one standard version and one expanded version – and that provide guidance on the adequate collection of data on livestock at household or farm level. The short version of the livestock module comprises approximately 30 questions and is intended for use as a module or a section of surveys within which livestock is of minor interest (such as living standards surveys or household income and expenditure survey). The standard version of the module comprises approximately 95 questions and is intended as a stand-alone livestock survey. The expanded version of the livestock module includes all of the questions in the standard version and adds information to all subsections. The short, standard and expanded versions of the livestock module for multi-topic household surveys may be downloaded from the website of the joint FAO, WB and ILRI Livestock Data Innovation in Africa Project (http://www.fao.org/3/a-i3706e.pdf).

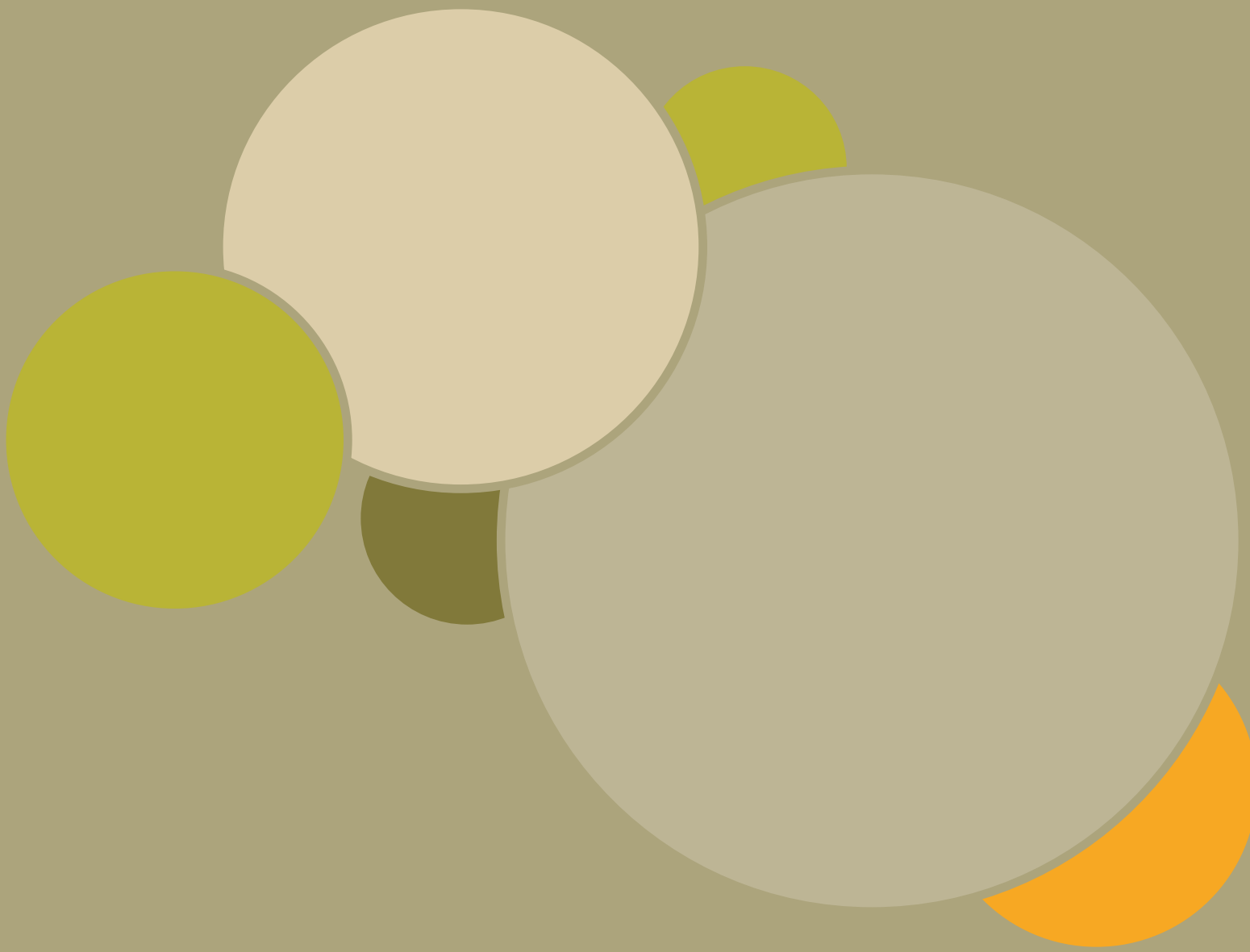
The Core and Rotating Modules of AGRIS, the ten-year integrated survey programme developed by the Global Strategy, envisage the collection of the majority of the livestock-related variables necessary to calculate the livestock production and productivity indicators discussed in these Guidelines. The AGRIS Core Module is supported by methodological notes and questionnaires to provide survey managers and operational staff with deeper knowledge on the key elements of survey implementation and the concepts and definitions used. According to the recommended AGRIS implementation flow, livestock production data re collected annually. Data on livestock production methods, including the use of veterinary products and services, feed and use of pastures, are collected through the rotating Module on Production Methods and the Environment twice in the ten-year period.

The AGRIS methodology has been developed within the framework of international statistical concepts and classifications. The questionnaires were designed on the basis of the experience and innovations of various international institutions and allow for further customization and implementation at national and subnational level. The data collection method envisaged is CAPI (GSARS, 2017).

Countries that are in the initial stages of planning their own livestock surveys may use the following examples as a basis for their questionnaires, which should nevertheless address their respective objectives and suit their survey infrastructure and budget.

As the types of animal vary by country, survey designers should include, in the survey module, only those animals that are significant to the country's livestock production system. Countries may also decide the level of detail required to determine the livestock inventory.

The formulation and level of detail of questions depends on the prospected use of the data items required to analyse and estimate livestock indicators, as well as the characteristics of the respondent farmers. Estimating for livestock production may be challenging, especially when small holdings constitute the largest share of the animal populations (as is the case in most developing countries).



6

Presentation of results for analysis: main tables for dissemination

The dissemination tables contain the results that will be made available to the general public and livestock stakeholders at the end of the livestock statistics production process.

The planning and design of the dissemination tables is therefore an essential part of the preparation phase of any survey. Logical and mathematical tests must be designed to check the validity and plausibility of the tabulated data.

Before tabulation, the individual records and auxiliary data must also be controlled and cleaned.

6.1. DATA CONTROL AND EDITING

The data collection process often suffers from errors of organizational, human or external nature that are usually difficult to measure and may lead to very serious deterioration of data quality. Non-sampling errors are common to both censuses and sample surveys, and may occur at each step of survey implementation. Many such errors may be anticipated during survey planning and prevented by providing intensive training to all survey staff and establishing procedures for monitoring and controlling data collection, entry and editing.

Data entry and validation plans depend on the survey mode applied. CAPI or web-based modes of data collection shorten the data processing period as the responses are already digitized. Usually, data validation rules are already incorporated and enumerators are automatically informed if the respondent's answers are suspect. If data validation is not online with already digitized data, the rules can be readily applied.

On the other hand, if the survey interviews are done using paper-based questionnaires, then data processing would involve data entry and validation. Specialized software could be used for this purpose, especially that including analytics or summary statistics that could be used to assess the performance of the data entry personnel. If Gold Standard data are available, these could be employed in data validation.

Countries tend to prefer decentralized data processing, to hasten data entry. The subnational offices of the agency in charge of the survey are tasked with entering the completed questionnaires from their respective areas and the first-tier validation. Suspect data are then verified, first by reviewing the completed questionnaires and, if necessary, by holding a second visit to the respondent farmers. The validated data files are then sent to the central office for consolidation and further validation.

Common non-sampling errors are the following:

- Failure to include all statistical units in the frame, or inclusion in the frame of non-belonging or duplicate units (frame imperfection – undercoverage or overcoverage);
- Failure of the enumerator to find the respondent or to record the answers correctly (missing or wrong data);
- Lack of cooperation on the part of the respondent (nonresponse) or difficulties in obtaining the respondent's answer, due to unclear or difficult questions (missing or wrong data);
- Errors due to data editing, coding, or entry (missing or mistyped data).

Because of the potential for human error and unanticipated issues with data collection procedures and forms, which may reduce data quality during collection and entry, close checking of the data sets is required before the results may be disseminated. The process of identifying and correcting non-sampling errors in the data is called data cleaning or editing. Some reading and tools on data cleaning and editing are presented in box 6.1.

Nonsampling errors generally result in outlier values or missing values.

An *outlier value* is one lying at an abnormal distance from other values within a variable, where the data have been recorded from a random sample of a population. In some cases, such values may be logically explained upon further exploration of their origins; however, in many cases, they may be due to an incorrect approach to measurement or errors in recording data on survey forms or during data entry.

A general approach towards identifying outlier values is to produce a frequency table from the variable of interest or to sort the variable column numerically, and then browse through the data at the upper and lower ends of the recorded data. The data can also be checked against other similar data sets or related research, to help identify clear outlier variables. Outlier variables may also be checked against the raw data (such as paper surveys or data recording cards). The values must be adjusted if there has been an error during data entry, or deleted if there is no other logical explanation.

Missing values occur when no data value has been recorded or stored for a particular variable in a particular observation or case. Missing values can have a significant impact on the conclusions drawn from the data, and must be accounted for carefully during data cleaning and analysis. Missing values are generally a result of a particular variable or variables being irrelevant to a particular observation (for example, an individual farmer being surveyed or an individual animal being measured). However, in some cases, missing values can be caused by errors during the research, for example data collection or data entry. A variety of techniques are available to address missing data.

Zero values are distinct from missing values in that they may often be a legitimate value within a variable. For example, the value of '0' is a legitimate response where survey respondents have been asked to indicate the number of sheep they own, and they own none. However, where an animal has been recorded in a data set but no girth measurement has been taken, '0' is not a legitimate value. In this case, the value would either be missing or coded with a pre-agreed number that represents a missing value, while not being a legitimate measurement (for example, '-999').

As is the case with outlier values, producing a frequency table of variables that may have missing and/or zero-value recording issues, or numerically sorting and then scanning the columns by eye, are the useful general approaches when diagnosing and correcting issues with missing or zero values.

During data collection, it must be ensured that enumerators understand the difference between 'missing' values and 'zero' values, and record each instance accurately. For example, where a hen has not laid an egg during one day of observation, the observation must be recorded as a 'zero' rather than a blank. In general, no field of the questionnaire should be left blank to avoid confusion between missing, 'zero' and non-applicable values. In the CAPI questionnaire, this is automatically controlled.

Data control is applied already from the stage of data collection and entry by the enumerator and data entry staff. During the training prior to data collection, enumerators must be made aware of the type or range of answers that can be expected to particular questions on livestock production and productivity. This may take the form of additional time spent during training to illustrate feasible livestock productivity responses, and for the enumerators to check closely with the farmer where an obvious 'outlier' response is being supplied. It may also take the form of listing examples of response ranges or types on paper- or tablet-based survey instruments.

Restricting the enumerators to selection from a range of fixed options (for example, a set of tick boxes or a Likert scale) may also reduce the likelihood of outlier data being collected, although this will not be possible where open-ended measurements are being collected.

Ensuring the thorough training of enumerators and data entry staff, as well as close supervision, can reduce the likelihood of outlier values, inconsistent data entry formatting, missing values, and the incorrect use of zero values occurring in the data set.

However, it is important to note that these and other issues are still likely to occur during data collection and entry, and that detailed checking and cleaning of data will still be an essential step before data analysis commences.

BOX 6.1. SUGGESTIONS FOR FURTHER READING ON QUANTITATIVE DATA CLEANING.

In addition to the manuals or user guides for statistical software, the following resources may assist in explaining data cleaning concepts and procedures.

General references

- Hellerstein, J.M. 2008. Quantitative Data Cleaning for Large Databases. EECS Computer Science Division, UC Berkeley. http://db.cs.berkeley.edu/jmh/papers/cleaning-unece.pdf, accessed 2/9/16.
- Osborne, J.W. 2013. Best Practices in Data Cleaning. Sage, Los Angeles.

Using SAS

- Cody, R. n.d. Data Cleaning 101. Robert Wood Johnson Medical School. http://www.ats.ucla.edu/stat/sas/library/nesug99/ss123.pdf, accessed 2/9/16.

Using R

- de Jonge, E. and van der Loo, M. 2013. An introduction to data cleaning with R. Discussion Paper, Statistics Netherlands. https://cran.r-project.org/doc/contrib/de_Jonge+van_der_Loo-Introduction_to_data_cleaning_with_R.pdf, accessed 2/9/16.

Using SPSS or Stata

- Department of Agricultural, Food and Resource Economics. 2012. Data Cleaning Guidelines (SPSS and Stata). Michigan State University. http://fsg.afre.msu.edu/survey/Data_Cleaning_Guidelines_SPSS_Stata_1stVer.pdf, accessed 2/9/16.

6.2. TABULATION

As a general principal of official statistics, all data collected not subject to confidentiality should be disseminated. One form of dissemination is the presentation of the data collected in tables (called tabulation). The prototypes of these tables, called the tabulation plan, should be developed together with the questionnaire and correspond to user needs and more frequent requests. Usually, in these tables, the data are grouped in classes. This section of the document presents some proposals for tabulation and is based mainly on the examples in the WCA 2020. The tables should be adapted to the question and answer categories included in the survey questionnaire.

The following tabulations are recommended:

TABLE 6.1. TOTAL NUMBER OF LIVESTOCK BY TYPE AND HERD SIZE CLASSES.

In the interests of coherence, the same size classes as those proposed by the WCA 2020 (see pp. 144–145) shall be used.

Livestock type:	Number of animals (heads)	Number of holdings (number)	Average number of animals (heads/holding)
Total			
Size class 1			
Size class 2			
....			

TABLE 6.2. TOTAL NUMBER AND LIVE WEIGHT OF LIVESTOCK BY TYPE AND CATEGORY OF LIVESTOCK.

Including category for breeding female animals

Livestock type:	Number of animals (heads)	Total live weight (tonnes)	Average live weight (kg/head)
Total			
Category 1			
Category 2			
....			

TABLE 6.3. MAIN FARM ENTRIES AND EXITS OF LIVESTOCK BY TYPE.

Livestock type:	Number of heads
Births	
Other entries of animals	
Animals slaughtered on the farm	
Animals slaughtered in slaughterhouse on farmer's behalf	
Animals sold for slaughter and other purposes	
Animals otherwise disposed of	
Other exits of animals	
of which deaths of animals	

TABLE 6.4. TOTAL NUMBER AND CARCASS WEIGHT OF SLAUGHTERED LIVESTOCK BY LIVESTOCK TYPE AND CATEGORY.

Including: Number of animals slaughtered on the farm, Number of animals slaughtered in slaughterhouse on farmer's behalf, Number of animals slaughtered in slaughterhouses and Number of animals slaughtered at other slaughtering points.

Livestock type:	Number of slaughtered animals (heads)	Total carcass weight (tonnes)	Average carcass weight (kg/head)
Total			
Category 1			
Category 2			
....			

TABLE 6.5. DESTINATION OF THE MEAT PRODUCED ON THE FARM.

Including only the animals slaughtered on the farm.

		By type of utilization (% or tonnes)				
	Total meat production on the farm (% or tonnes)	For home consumption of the holding's household	Sold	Used as pay for labour	Given to service or input providers	Given as gift
Cattle meat						
Sheep meat						
Goat meat						
Pig meat						
Poultry meat						

TABLE 6.6. TOTAL QUANTITY OF MILK PRODUCED PER TYPE: COW, SHEEP AND GOAT.

	Number of milking animals (heads)	Average milk production (t/head)	Total milk production (tonnes)
Total			
Cow			
Sheep			
Goat			

TABLE 6.7. TOTAL QUANTITY OF MILK PRODUCED PER TYPE: COW, SHEEP AND GOAT; AND MILK UTILIZATION.

		Of which raw milk used for (% or tonnes)				
	Total milk production (% or tonnes)	Home consumption of the holding's household	Animal feed	Processing on the farm	Sold as raw milk	Other use
Total						
Cow						
Sheep						
Goat						

TABLE 6.8. TOTAL NUMBER EGGS PRODUCED, PER BREED.

	Number of laying hens (1 000 heads)	Average egg production per hen per year (number/head)	Total egg production in numbers (1 000 eggs)	Total egg production in tonnes
Total				
Breed 1				
Breed 2				
....				

TABLE 6.9. TOTAL NUMBER OF EGGS PRODUCED, PER BREED; EGG UTILIZATION.

		Of which eggs used for (% or tonnes)			
	Total egg production (% or tonnes)	Home consumption of the holding's household	Hatching	Sold	Other use
Total					
Breed 1					
Breed 2					
....					

TABLE 6.10. USE OF FEED PER LIVESTOCK TYPE, TYPE AND SOURCE OF FEED.

Livestock type:				
	Total quantity of feed used (% or tonnes)	Of which per source (% or tonnes)		
		Own production	Purchased	Otherwise acquired
Feed 1				
Feed 2				
Feed 3				
....				

TABLE 6.11. USE OF VETERINARY SERVICES (NUMBER OF HOLDINGS).

	Total number of holdings	Of which holdings that	
		have used veterinary services	have not used veterinary services
Livestock type 1			
Livestock type 2			
Livestock type 3			
....			

TABLE 6.12. USE OF VETERINARY SERVICES (NUMBER OF ANIMALS).

	Total number of animals	Of which animals that	
		have received veterinary services	have not received veterinary services
Livestock type 1			
Livestock type 2			
Livestock type 3			
....			

7

Resources

7.1. COSTS OF LIVESTOCK DATA COLLECTION

Few consistent sets of statements are available about the costs of data collection. These Guidelines offer an overview of the basis for cost calculations, a presentation of the physical and organizational aspects of data collection that contribute to costs, some examples of cost calculations and the derived anatomy of the costs, and guidance on factors affecting costs. Finally, analytic aspects of the benefits and costs of alternative data collection methods are discussed.

7.1.1. Physical and organizational aspects of costs

The costs of data collection depend on physical and financial quantities. Physical quantities relate to the numbers of survey staff (primarily enumerators), how fieldwork is supervised, and the delivery of training to enumerators and supervisors. These numbers, in turn, depend on the sampling and survey strategies employed, the physical distances between the survey accommodation and the data collection points, and the intensity of survey activities (especially their number, duration and nature).

When planning data collection, the assumptions made with regard to these variables must be specified and employed in budgeting. A useful approach towards formulating these assumptions is to identify the sample size, the capacities of enumerators and physical facilities (for example, the likely number of interviews per hour or the maximum sizes of the groups, in case of focus groups approach), and training requirements. Table 7.1. lists a basic set of assumptions employed in the cost calculations discussed in these Guidelines.

The calculation and interpretation of data collection costs is aided by appropriate numeraires (units of analysis). It is suggested that the costs per interview, per year or per enumerator are useful for ex post analysis of large-scale programmes; however, they are not relevant to the ex ante design of data collection. In the absence of a widely accepted numeraire, these Guidelines adopt the term "survey day", which is then used as a reference for cost items. The advantages of this numeraire are that it is directly related to the physical and organizational aspects of data collection actions, and that it can be applied to a variety of scales by simply multiplying by the duration (number of days) of data collection. It should be noted that the duration of the data collection also depends on the basic assumptions on requirements and capacities. Table 7.1. presents the basic assumptions made on the "survey day" basis for cost calculation.

Examples are provided for the assumed supervisor/enumerator ratios and transport and accommodation costs per survey worker, the sizes of the groups for focus groups and the form and duration of training events for enumerators and supervisors. These assumptions are based on the experience gained during the field-tests of the GS project on "*Improving Methods for Estimating Livestock Production and Productivity*".

TABLE 7.1. BASIC ASSUMPTIONS FOR COST CALCULATIONS.

Scale of data collection and training activities					
Sample size	350	Respondents			
Interviews/day/2 enumerators	7	Interviews per day			
Communal event size	80	In communal data collection for one day			
Training duration	2	Days			
Data entry duration	3	Days			
Staffing					
	Enumerators	Supervisors	Extension officers or others	Drivers	Cars
Training	6	2			
Survey	6	2	2	2	2
Data entry	3	2			
Communal data collection	6	2	3	2	2
Derived measures					
Length of interview	1.14	Hours			
Days to conduct survey	4.2	Days			
Days to conduct communal events	4.4	Days			

7.1.2. Calculation of financial costs

Individual elements of the costs of data collection will differ between countries. For this reason, these Guidelines discuss the practical experience of three pilot countries involved in the GS project titled "Improving Methods for Estimating Livestock Production and Productivity" (table 7.2.). The intent of these tables is to list the relevant variables and present the values drawn from this experience, rather than prescribe or predict cost levels in any particular country or context. Pilot country data collection activities involved limited and truncated data collection tasks, generally associated with small numbers of variables and indicators. The application of these data then requires a generalization of the actual cost information to represent practically sized activities, centred upon a "survey day", defined as above as a sample of 350 households and a team of six enumerators carrying out conventional face-to-face recall questionnaire-based surveys at a rate of seven household interviews per day.

The costs of data collection work per survey day amount on average to approximately USD 2 700, including training. Separate estimates of focus groups average USD 2 440 per survey day, which includes transport allowance and lunch for farm household participants. It should be noted that accommodation and meals dominate these cost estimates: such expenses are fully recorded for enumerators and supervisors, both for survey and data collection work and for training periods.

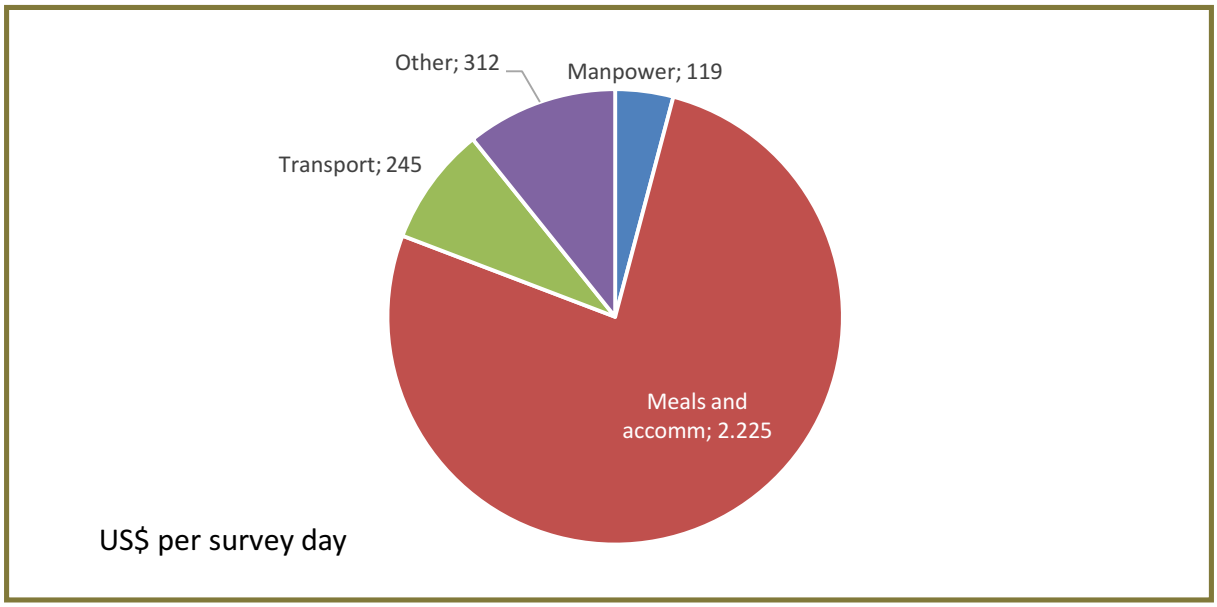
TABLE 7.2. DATA COLLECTION COSTS PER SURVEY DAY: PILOT COUNTRY ESTIMATES AND AVERAGE.

	United Rep. Of Tanzania	Botswana	Indonesia	Average
	USD/survey day	USD/survey day	USD/survey day	USD/survey day
Training costs				
Trainers' time	53	11	32	32
Trainees' time	118	15	48	61
Meals	18	77	14	36
Accommodation	326	288	283	299
Transport	9	38	14	20
Facilities	219	96	35	117
Equipment	219	96	35	117
Stationery	219	96	35	117
Total training costs	**1 181**	**717**	**497**	**799**
Survey costs				
Personnel				
Supervisors	110	23	67	67
Enumerators	247	31	100	126
Extension officers and local official per diems	82	18	44	48
Drivers	73	23	44	47
Logistic costs				
Fuel	44	40	37	40
Car R&M	110	144	144	133
Phone cards	31	24	24	26
Meals	219	960	177	452
Accomodation	1 020	900	883	934
Data entry				
Enumerators	89	11	36	45
Supervisors	79	10	48	46
Total survey costs	**2 102**	**2 184**	**1 605**	**1 964**
Total costs of training and survey	**3 283**	**2 901**	**2 102**	**2 762**
Communal data collection				
Supervisors	110	23	67	67
Enumerators	247	31	100	126
Extension officers and local official per diems	123	27	66	72
Drivers	73	23	44	47
Car R&M	104	137	137	126
Fuel	11	40	37	29
Meals	365	960	294	540
Accommodation	850	600	589	680
Transport	183	800	294	426
Other costs	183	400	400	328
Total costs of communal data collection	**2 248**	**3 041**	**2 030**	**2 440**

Based on the above considerations, a survey of approximately 350 households would last 4.2 days and cost approximately USD 11 000. For focus group involving the same 350 households and targeting a similar number of indicators, approximately 4.4 days would be required, at a total cost close to USD 10 000. A blend of the two approaches – for example, devoting a single day to focus group activities and the remaining time to survey work – would reduce the costs of both exercises.

A calculation of the costs per survey day, where the data collection activities entail face-to-face interviews with producers in Botswana on animal numbers and herd sizes is presented in figure 7.1. As may be seen, the total cost per survey day (USD 2 901) is dominated by meals and accommodation costs as outlined above. An immediate observation is that where local enumerators can be employed, there is potential for these costs to be reduced.

FIGURE 7.1. EXAMPLE OF DISTRIBUTION OF DATA COLLECTION COSTS FOR A SINGLE SURVEY ACTIVITY, BOTSWANA.



7.1.3. Cost aspects of the Gold Standard

Gold Standard studies, even those with self-imposed limitations due to budget constraints, are expensive to develop and implement. Cost estimates established during the implementation of the GS project on "Improving Methods for Estimating Livestock Production and Productivity" suggest that even limited Gold Standard studies can incur costs ranging from USD 50 000 to USD 200 000.

The collection of Gold Standard data for livestock production and the productivity of holdings from the household sector requires actual measurements to be taken from individual animals. Table 7.3. presents cost items and structural assumptions for Gold Standard data collection exercises in milk production, egg production, and measurement of growth rates in small ruminants. These Gold Standard survey parameters apply to small and concentrated samples, being 65 households at four cows per household (milk), 100 households at ten laying hens per household (eggs), and 55 smallholder ruminant households with 50 animals to be weighed per household. Two options are presented:

a. all measurement activities completed by enumerators, and
b. using smallholder farmers to carry out most measurements.

The financial elements of the calculation are presented in table 7.4.

TABLE 7.3. PHYSICAL PARAMETERS AND ASSUMPTIONS APPLICABLE TO GOLD STANDARD DATA COLLECTION.

Gold Standard data collection: cost items			
	MILK	EGGS	LIVEWEIGHT
Number of households	65	100	55
Animals/household	4	15	50
Number of measurements days/household	65	120	2
Number of measurements/day/household	2	1	0.1
Total measurement required	33 800	180 000	550
(a) Enumerator collection			
Number of enumerators	20	15	10
Number of supervisors	6	4	5
Number of cars with drivers	6	3	2
Training days for enumerators (days)	1	1	1
Measurements/enumerator/day	26	100	28
Accommodation and meals (days)	2 106	2 659	49
Fuel for cars (litres @ 30 litres/days)	1 950	3 600	825
Number of gifts to households (small items)	65	100	55
Support from extension officers	2	2	2
Buckets and measuring scoops	30		
Soft pens		100	
Animal scales			10
(b) Farmer collection			
Number of enumerators	4	2	3
Number of supervisors	2	1	1
Number of cars with drivers	2	1	3
Training time spent by enumerators (days)	2	2	2
Accommodation and meals (days)	532	486	22
Fuel for cars (litres @ 30 litres/days)	390	480	248
Number of gifts to households (small items)	65	100	55
Support from extension officers	2	2	2
Buckets and measuring scoops	65		
Soft pens		100	
Animal scales			45

TABLE 7.4. FINANCIAL ITEMS FOR COST CALCULATION IN GOLD STANDARD DATA COLLECTION.

Gold Standard data collection: price items	USD
Enumerators (USD/day including weekends)	24
Supervisors (USD/day including weekends)	52
Drivers (USD/day including weekends)	35
Trainers (USD/day)	60
Fuel (USD/litre)	1.5
Car R&M (USD/litre)	0.75
Accomodation and food (USD/day)	50
Cost of capital items	
Buckets and measuring scoops	35
Soft pens	5
Animal scales	2 200
Gift to households	12
Payments to households	50
Payments to extension officers (USD/day)	12

Using these physical and financial elements, total costs are presented in table 7.5. It may be seen that even in settings with small and concentrated sampling, the measurement-intensive nature of Gold Standard activities entail high costs. The 120-day and 100-household egg production measurement survey proposed here, for example, costs approximately USD 234 000, of which the great majority is composed of labour, and accommodation and meals for field staff. Reducing these costs by using farm household labour (farmers provided with training to conduct their own measurements) is very effective for all three commodity contexts considered here, and the same data collection exercise on egg production can be conducted for approximately USD 64 000 or one quarter of the enumerator-based action.

Where Gold Standard data collection involves the use of expensive capital items (such as cattle scales), the capital costs of provision to all or most households (as in this example) can offset labour savings to the extent that farmer measurement becomes the more expensive of the two options.

TABLE 7.5. TOTAL COST ESTIMATES FOR GOLD STANDARD DATA COLLECTION.

Gold Standard cost calculation	MILK	EGGS	LIVEWEIGHT
(a) Enumerator collection			
Labour costs (USD)			
Enumerators	31 200	43 200	6 600
Supervisors	20 280	24 960	7 150
Drivers	13 650	12 600	1 925
Trainers	3 900	7 200	1 650
All labour	69 030	87 960	17 325
Other costs			
Accommodation and meals	105 300	132 950	2 450
Fuel and other transport costs	4 388	8 100	1 856
Gift to farmers	780	1 200	660
Payments to extension officers	1 560	2 880	330
Capital items	1 050	500	22 000
All costs	**182 108**	**233 590**	**44 621**
(b) Farmer collection			
Labour cost (USD)			
Enumerators	6 240	5 760	1 980
Supervisors	6 760	6 240	1 430
Drivers	4 550	4 200	2 888
Trainers	7 800	14 400	3 300
All labour	25 350	30 600	9 598
Other costs			
Accommodation and meals	26 600	24 300	605
Fuel and other transport costs	878	1 080	6 806
Gift to farmers	3 250	5 000	1 513
Payments to extension officers	1 560	2 880	55
Capital items	2 275	500	99 000
All costs	**59 913**	**64 360**	**117 576**

These cost estimates for Gold Standard data collection require a number of clarifying statements.

- The data collection activities presented target a number of variables and indicators. Simplifying and truncating the data collection task would shorten collection times and reduce the staffing levels required.
- The cost estimates presented refer to exercises on single species. Where multiple measurement tasks on several species can be conducted with the same households, appreciable savings can be made by sharing between activities.
- In each case, the length of the data collection exercise is a major determinant of cost.
- The costs of enumerator and supervisor labour is sensitive to assumptions concerning the use of weekends and breaks, particularly where the survey staff have been brought in from outside the survey location.

7.1.4. Management steps to reduce data collection costs

The estimates of data collection costs presented here are direct consequences of the assumptions and parameters employed above. The opportunities for reducing data collection costs centre upon these assumptions. These opportunities include:

- Use of local enumerators;
- Reduced length of overall data collection activities, and other planning so as to avoid staff accommodation and food expenses during downtime (such as on weekends and public holidays);
- Use of alternative technologies (discussed further below);
- Reductions in sample size;
- Changed structure and spatial arrangement of samples to minimize transport and other logistic costs, thus saving enumerator time;
- Changes to questions and questionnaires to generate more data per unit of survey staff time;
- Changes to nature of enumerator activities to reduce training and supervision costs;
- Use of existing data (such as sales figures held by buyers, or accounts of animal numbers held by animal health authorities);
- Use of farmers as enumerators (discussed further below).

7.2. EVALUATING CHANGES IN DATA COLLECTION METHODS

7.2.1. Benefits of change

Enhanced data quality (including, but not limited to, standard criteria of relevance, accuracy, reliability, timeliness, punctuality, coherence, comparability, accessibility and clarity) and reduced costs of collection are in general the main benefits sought when changing data collection method. Other benefits of changed data collection methods include:

- Greater detail, clarity or disaggregation of indicators;
- Inclusion of new indicators;
- Expanded skills of household members and improved information flows to the smallholder producer;
- Enhanced potential for integrating livestock data with data from other sources;
- Enhanced understanding and organizational synergy between branches, agencies and levels of government, as well as with rural communities.

7.2.2 Comparison methods

The evaluation of new data collection methods requires a comparison between existing and proposed alternatives on one hand, and reference to actual measures of target indicators and variables (a “Gold Standard”) on the other. Variations on this theme are possible, particularly in addressing specific data quality criteria. The costs of Gold Standard data collection and of the method more generally are presented above as a case study of the work done during the GS project on “Improving Methods for Estimating Livestock Production and Productivity”. As with treatments of data collection costs more generally:

- Extrapolation to larger scales has been used to better represent costs; and
- Opportunities have been identified for cost reductions by selected management steps.

7.3. SKILLS REQUIRED FOR DATA COLLECTION

7.3.1. Skill sets required of data collection staff

The collection of livestock production and productivity data requires a team with project managers, survey team managers or supervisors, enumerators, data entry staff, and researchers or statisticians with relevant experience in data analysis, interpretation, and reporting. The skill sets required are detailed in table 7.10.

TABLE 7.6. DATA COLLECTION SKILL SETS.

Data collection role	Skill sets
Project/research managers and staff	• Academic research experience in the livestock sector • Experience in designing and testing survey instruments • Experience in relevant statistical and analytical procedures for livestock data • Ability to interpret results and prepare project reports • Ability to disseminate results to academia, industry and other stakeholders • Local knowledge and relevant languages
Survey managers	• Knowledge of enumeration and data entry processes • Ability to lead and supervise enumerator and data entry team • Ability to plan and implement a livestock data collection project • Good understanding of livestock production and productivity concepts relating to specific data collection exercises • Local knowledge and relevant languages
Enumerators	• Knowledge of social survey interviewing, and collection of data using paper-based or electronic data collection forms • Knowledge of livestock measurement methods, where relevant • Relevant experience in livestock handling and measurement. • Understanding of production concepts relating to livestock species being researched • Local knowledge and relevant languages
Data entry operators	• Knowledge of database or spreadsheet applications used for data entry processes • Basic knowledge or understanding of livestock concepts • Attention to detail and accuracy • Experience in relevant languages

7.3.2. Involvement of farmers in data collection

These Guidelines have sought to respond to the widespread calls – from agricultural and livestock agencies, and local authorities involved in administrative data collection and use – for increased farmer involvement in livestock data collection. Reasons for this change include:

- Sensitization (as mentioned above) of farmers to concepts and practices of information use in management, particularly, encouragement towards record-keeping;
- Easing of cost and logistics burdens away from public servants;
- Costs savings associated with the reduced need for enumerators;
- Transfer of tasks away from survey personnel without in-depth knowledge of livestock systems, allowing them to concentrate on the statistical rigour of the livestock data system.

According to the experience behind the preparation of these Guidelines, there are varied levels of enthusiasm for data collection activities among farmers, including even for simple record-keeping. There may be reasons to believe that production and productivity on a farm is correlated with farmer enthusiasm, such that substantial sample bias would be introduced by a wholesale move to a farmer-volunteer-based data collection method.

Potential cost savings from using farmers as data collectors are offset by the need to reward or remunerate farmers for their work, and to provide essential measurement equipment. In this situation, a certain degree of synergy exists: measurement equipment such as tape measures and buckets are cheap and may have alternative uses in the farm household. Some equipment, however, is too expensive to provide to all farmers (such as cattle scales), while other tools require constant calibration (for example, scales for weighing eggs). The presence of rewards for participation in data collection also introduces a source of sampling bias, which must be countered by a random approach according to sampling strategy.

Farmer participation in repetitive data collection tasks over prolonged periods (such as during a Gold Standard study) is likely to be characterized by poor-quality collection, due to farmer fatigue with the process or general failure to perceive any benefit from the tasks. Further, farmers may see fit to exaggerate animal or farm performance, or favour the involvement of animals with superior performance. These Guidelines suggest that these aspects of sampling must be addressed by strong sampling procedures and the tagging or marking of animals. Where multiple measures of variables involve long intervals (for example, animal weighing to determine growth rates), experience indicates that difficulties have been encountered in locating animals for repeat measurement.

Focus groups are discussed in an earlier chapter. Farmer attendance of such events encounters many of the same potential sources of sampling bias outlined above, as well as the possibility of the introduction of spurious data underlined by the absence of any immediate means of validation by an enumerator.

7.3.3. Training of data collection staff

The costs and intensities of training survey staff have been presented above as part of the underlying assumption set surrounding cost calculations. Cost components include transport and meals, trainers' time, equipment and consumables, and payment for the trainees' time. For the most part, training activities can be expected to be carried out in locations where the trainees live; however, time constraints or other considerations may require centralized training, to which trainees must travel.

These Guidelines advocate a training regime that instils understanding of the purpose of data collection, the nature of its application and form of its output, the nature of the variables for which data is being collected, and the avenues by which information is to be elicited. In order that this understanding is common to both enumerators and supervisors, the two groups need to be engaged in training together. Training must specify criteria for the quality of products (data sets delivered) and the process (how the data is collected and at what cost).

The training content must also include:

- Sensitivity to the language, education level and culture of respondents, and the specification of strategies to accommodate these;
- An understanding of the logistics of the data collection activity and the daily demands of the work;
- Specification and development of skills for roles in, and interfaces with, quality control procedures and assessments;
- Specification and development of skills for roles in, and interfaces with, data entry and data cleaning.

8

Integrated survey programme

8.1. NEEDS FOR AN INTEGRATED SURVEY SYSTEM

In many countries, agricultural surveys are conducted on an ad hoc basis without an overall statistical programme, strategy, or links to an MSF. In these cases, it is difficult to integrate data from various surveys for further analysis. In the absence of structural data for the entire agricultural sector that provides the basis for analysing the characteristics of farms, the division of the production of crop and livestock data leaves no opportunity to compare and measure the impact of an action within or between agricultural subsectors.

Household surveys are often conducted in isolation from production surveys or with small sample sizes that cannot disaggregate the rural and farm sectors (World Bank and FAO, 2011). Similarly, data is often collected by subsector, using different sampling frames and surveys with multiple governmental organizations involved in its collection of data without coordination from other departments. In some cases, different organizations produce statistics for the same items, with different results.

The Global Strategy to Improve Rural and Agricultural Statistics (World Bank, 2011) suggests that an integrated statistical system can resolve many of these problems by reducing the duplication of efforts, preventing the release of conflicting statistics, and ensuring the best use of resources. Methods, concepts, and classifications can be standardized and allow for more systematic data collection across sources. These practical advantages of integrated data systems, together with the increasing need for reliable and comparable data in a context of globalization and international concern, points to the need for integrated national statistical systems. This integration will be accomplished by:

1. the development of an MSF for agriculture, including livestock;
2. its use within a coordinated data collection program to produce timely and accurate data;
3. a strategy for effective data dissemination that ensures accessibility.

Indeed, the Global Strategy developed the AGRIS, which proposes a ten-year modular data collection scheme based on a master frame (GSARS, 2015), ensuring data coherence in time and among thematic sets of core variables. The options for building the master frame are left to the discretion of the national authorities, as they all inherit very different systems. If a decennial agricultural census is operational, it will naturally provide the basis for the elaboration of the master frame. If only a household population census is performed periodically, the inclusion of a targeted agriculture module will enable the derivation of the agriculture master frame for the household sector. In other cases, the construction of an area frame (points or segments) will provide an efficient solution. In all scenarios, the geolocalization of sampling units will be necessary, and multiple frames will generally improve frame quality by merging list and area frames with administrative sources (especially for the non-household sector).

8.2. OVERVIEW OF AGRIS[1]

AGRIS is a farm-based modular multi-year sample survey program that aims to complement other relevant initiatives, such as the World Bank LSMS-ISA and to scale up these global efforts. As one of the main features of cost-effective methods, AGRIS is designed to help national agencies accelerate the production of quality disaggregated data on the technical, economic, environmental and social dimensions of agricultural holdings. AGRIS builds on the previous work of the Global Strategy to present a unique opportunity to channel these methodological innovations and achieve real effects on data systems on the ground. AGRIS, being a ten-year integrated survey program, lays the foundations for the creation of an efficient agricultural statistical system. Together with the agricultural census that it complements, a versatile agricultural market information system, and an appropriate use of remote sensing and administrative data, AGRIS is a cornerstone for the establishment of a comprehensive rural information system.

AGRIS is designed in a way to serve an integrated national statistical system and is composed by a Core Module and a series of four Rotating Modules. Each module measures different key aspects of the agricultural sector and is fielded with different frequencies. The AGRIS Core Module is an annual sample farm survey having the main objective of measuring a key set of indicators related, in particular, to the volume of agricultural production (crop and livestock). In addition, the Core Module measures the key social, economic and technical dimensions of the holding. In addition, a series of Rotating Modules will take place at varying frequencies, when possible based on the samples of the Core Module. These Rotating Modules bring additional knowledge on thematic domains: Economy, Labour, Production Methods and the Environment, and Machinery, Equipment and Assets. AGRIS is mainly conceived for developing countries and is currently tested in some of them.

The recommendations on sampling strategies are issued at two levels. First, commercial farms are separated from households, a fact that favours the design of a two-stage stratified plan for households and a one-stage stratified sampling for commercial holdings. Second, samples should be rotated in time, to limit survey burden and allow for the analysis of longitudinal panel data, which is particularly efficient when observers are interested in estimating the evolution of trends.

Finally, the link with SDGs is acknowledged (UN, 2017), the proposed set of AGRIS Generic Questionnaires will generate basic data for monitoring the relevant SDGs. Among the 232 SDG indicators, AGRIS provides essential and direct information for four SDG indicators and essential but indirect information for another 15 SDG indicators.

1 GSARS. 2017. Handbook on Agricultural Integrated Survey (AGRIS), available at http://gsars.org/wp-content/uploads/2018/05/AGRIS-HANDBOOK-completo-02-24.pdf

8.2.1. The AGRIS Cycle

AGRIS is synchronized with the agricultural census and operates over a ten-year cycle. AGRIS seeks to decrease the burden of conducting censuses by scheduling the collection of thematic data over this time frame. This will contribute to a more regular flow of data, which would be more in line with the limited capacities currently in place for the production and use of statistics.

AGRIS consists of a collection of questions that can be classified into one of two main categories: a core section and a rotating section. The core section (also referred to as the 'Core' or 'Core Module') is an enhanced production survey that also focuses on a range of different themes, which remain largely the same in each survey round. The rotating section (which comprises several 'Rotating Modules') is devoted to specific themes, the implementation frequency of which will vary among countries with different agricultural systems and data demand priorities.

The following table summarizes a possible module flow for the four recommended Rotating Modules: 'Economy', 'Labour', 'Production Methods and the Environment', and 'Machinery, Equipment, Assets'. The financial and human resources required to sustain and implement such an arrangement is relatively stable over the ten-year cycle, making it a viable set-up for a data producing agency. The flexible, modular nature of AGRIS makes it easy to modify this proposed setting and thus enhance its national relevance and cost-effectiveness. Additional Rotating Modules may also be added to respond to additional specific data needs.

TABLE 8.1. RECOMMENDED AGRIS MODULE FLOW.

	Years	1	2	3	4	5	6	7	8	9	10
Core Module	Agricultural holding (AH) Roster	•	•	•	•	•	•	•	•	•	•
	Crop + livestock production	•	•	•	•	•	•	•	•	•	•
	Other key variables	•	•	•	•	•	•	•	•	•	•
Rot. Module 1	Economy	•		•		•		•		•	
Rot. Module 2	Labour		•				•				
Rot. Module 3	Production Methods and the Environment				•				•		
Rot. Module 4	Machinery, Equipment and Assets	•				•					

To enhance respondent recall and provide timely information for market efficiency and decision-making, data collection activities could be conducted several times during the year. This is particularly true for the Core Module in countries with several crop periods. Rotating Modules, in particular the Economy and Labour Modules, could also require several waves of data collection during their years of implementation. Subsampling plans could be used to accommodate budget constraints, while producing more frequent data with different levels of statistical significance. The use of CAPI technologies is recommended to improve data quality and timeliness.

AGRIS covers different technical, economic, environmental and social dimensions of agricultural holdings through its Core Module and its four Rotating Modules.

AGRIS collects sex-disaggregated data on key topics through both the Core and the Rotating Modules. This entails a more refined identification of male- and female-headed households and will help to assess women's contribution to agriculture through labour, and their access to and control of productive assets, resources and services. More details on topics covered can be found in GSARS (2017).

8.2.2. Coverage of SDG indicators

The data generated by AGRIS is meant to inform policy design and implementation, improve market efficiency and support research. AGRIS constitutes an invaluable data source and provides the framework for designing, monitoring and evaluating any agricultural or rural policy or investment. The proposed generic AGRIS questionnaires cover most of the farm-level MSCD data requirements. They also provide basic data for monitoring the relevant indicators for the SDGs, a set of goals adopted by countries on 25 September 2015 to end poverty, protect the planet, and ensure prosperity for all as part of a new sustainable development agenda[2]. Each goal envisages specific targets to be achieved over the next 15 years, and each of these targets has specific indicators [3] AGRIS provides essential and direct information for the following four SDG indicators:

- 2.3.1: Volume of production per labour unit producers, by sex and indigenous status
- 2.4.1: Proportion of agricultural area under productive and sustainable agriculture
- 5.a.1: (a) Proportion of total agricultural population with ownership or secure rights over agricultural land, by sex; and (b) share of women among owners or rights-bearers of agricultural land, by type of tenure

AGRIS contributes to the following 15 additional SDG indicators, on the subpopulation of the population associated with agricultural holdings only:

- 1.1.1: Proportion of population below the international poverty line, by sex, age, employment status and geographical location (urban/rural)
- 1.2.1: Proportion of population living below the national poverty line, by sex and age
- 1.2.2: Proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions
- 1.3.1: Proportion of population covered by social protection floors/systems, by sex, distinguishing children, unemployed persons, older persons, persons with disabilities, pregnant women, newborns, work-injury victims and the poor and the vulnerable
- 1.4.1: Proportion of population living in households with access to basic services
- 1.4.2: Proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and by type of tenure
- 1.5.1: Number of deaths, missing persons and directly affected persons attributed to disasters per 100 000 population
- 2.5.2: Proportion of local breeds, classified as being at risk, not-at-risk or unknown level of risk of extinction
- 5.5.2: Proportion of women in managerial positions
- 5.b.1: Proportion of individuals who own a mobile telephone, by sex
- 7.1.1: Proportion of population with access to electricity
- 8.7.1: Proportion and number of children aged 5-17 years engaged in child labour, by sex and age
- 9.1.1: Proportion of the rural population who live within 2 km of an all-season road
- 9.c.1: Proportion of population covered by a mobile network, by technology
- 17.8.1 Proportion of individuals using the Internet

2 http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E
3 https://unstats.un.org/sdgs/metadata/

8.3. INSTITUTIONAL SETTING

The collection of livestock production and productivity data lies within the overall integrated survey framework. The methods advocated and discussed in these Guidelines are appropriate for use in both administrative data procedures. In all cases, the methods tested sought to extend or expand the functionality of systems, in line with stakeholder needs as outlined in the gap analysis. In particular, the indicators selected for testing new approaches have the broadest possible appeal within the integrated system. In the case of testing in Indonesia, additions to the sample frame were made because livestock-keeping smallholders were not within that country's framework at the time. In the case of Botswana, indicators of feed use were tested in preference to existing indicators of presence and absence of feeds on farms. In the case of egg production in the United Republic of Tanzania, a new approach to measurement of productivity was tested which used clutch-based indicators rather than summaries of total production.

8.4. STEPS IDENTIFIED AND THE CONTRIBUTIONS OF THE GUIDELINES

The contribution of these Guidelines to each of these is presented in the table's second column, with further comments added.

TABLE 8.2. STEPS TOWARD ESTABLISHMENT OF AN INTEGRATED SYSTEM, AND ASSOCIATED ELEMENTS OF THESE GUIDELINES.

Step	Contribution of Guidelines
1. Link a country's livestock production and productivity plan to the global strategy framework;	• Support to the adoption of the Global Strategy's first pillar in establishing a minimum set of core data, defined in close consultation with stakeholders to identify current and emerging demands, as well as opportunities. • Support to the adoption of the Global Strategy's second pillar by improving existing statistical systems, achieved by demonstrating and documenting: use of existing sampling frames; integration of data from existing sources and in different forms; and employment of benchmarking for quality. • Support to the adoption of the Global Strategy's third pillar by contributing to the sustainability of statistical systems. This is achieved by documenting the evaluation of proposed new collection methods and identification of low-cost approaches and necessary skills.
2. Identify the core livestock indicators required by different stakeholders along with frequency, level of aggregation and precision required;	• GAP analysis identifying high-priority indicators. • Evaluation of data quality in existing data, including precision as a criterion • Level of aggregation linked to production systems' classification and sampling strategy
3. Identify appropriate data collection methodologies and which agencies have the capacity to collect the data;	• Alternative methods identified and tested, extending to: • improved clarity, changed focus and enhanced seasonal precision of recall questions; • physical or proxy measurement of selected production variables; • improved measurement of feed use and inclusion of communal pasture quantity, quality and sustainability; • inclusion of animal weights and growth rates; • extension of data collection to smallholders previously omitted; • testing and review of farmer participation in data collection.
4. Given the limited budgets often encountered in developing countries, prioritize the activities for implementation;	• Identification of cost items and patterns, and specification of budgets for various forms of data collection • Derivation of value for money, directed at individual indicators and groups of indicators, and associated with changes in methodology • Presentation of feedback from agencies implementing test activities
5. Identify any capacity building and training required by organizations responsible for implementation; and	• Identified technical capacities and skills necessary for various data collection methods • Identified training needs associated with new methods, expressed as additional needs due to adoption of new methods • Costs of training incorporated into budgets for data collection
6. Identify the resources needed to successfully implement the data collection.	• Advocacy of clustered sampling • Identification of cost-mitigating strategies for data collection practice, enabling lowest-cost implementation • Identification of cost-reducing optons for implementation of Gold Standard methods • Commentary on farmer roles in data collection

Glossary of key concepts

Agricultural holding: economic unit of agricultural production under single management comprising all livestock kept and all land used wholly or partly for agricultural production purposes, without regard to title, legal form or size.

Animal girth measurement: measuring the heart girth (just behind the front legs) of ruminant and non-ruminant livestock to provide a proxy measurement of livestock weight. A weight tape is often used to simplify conver-sion of animal girth to weight, being marked with a conversion such that a relatively accurate estimate of the animal's body weight is shown on the tape.

Census: statistical collection involving the enumeration of all units (large sample-based collections are some-times also referred to as censuses).

Cluster sampling: a process where a large group of individuals (a population) is divided into a 'natural' but rela-tively heterogeneous group, and a random sample of each group surveyed to identify differences across the cluster. An example may be to cluster a population on the basis of their village location, or their form/s of agri-cultural production.

Direct measurement: measuring exactly the item or object that the researcher is seeking to collect data on (for example, milk production or the current weight of livestock).

Enumerator: a person employed to implement a survey, for example by interviewing farmers and recording their responses on a questionnaire form, or by measuring livestock characteristics and recording the data.

Focus group data collection: group-based questioning, in which a group of respondents are asked to provide an aggregated response to survey questions.

Holding in the household sector (Small holding): holdings that are operated by a civil (natural) person or group of civil (natural) persons which produce agricultural products mainly for own consumption.

Holding in the non-household sector (Commercial holding): Holdings in the non-household sector are holdings that are in sectors other than the household sector, such as corporations and cooperatives. Holdings that are op-erated by a legal person and have a hired manager are included in this definition. Holdings operated by a civil (natural) person but are business-oriented and behave as corporations are also included here.

Livestock type/species: the classes of livestock as included in WCA 2020, Annex 6 – Classification of livestock. The main livestock types and species covered by these Guidelines are cattle, sheep, goats, pigs and poultry.

Livestock category: Subdivisions of the livestock types or species per age, sex and purpose.

Livestock system: The general characteristics and practices of raising livestock on the holding. The following types of livestock system are identified by FAO: Grazing system, of which Nomadic or totally pastoral, Semi-nomadic, semi-pastoral or transhumant and Sedentary pastoral or ranching; Mixed system and Industrial sys-tem.

Large ruminant: domesticated mammals used for meat, fibre and milk production that include cattle and buffa-lo.

Non-response: nonobsevation or failure to obtain a measurement on one or more variables for one or more ag-ricultural holdings during the survey.

Observation unit: those entities on which information is received and statistics are compiled. During the collec-tion of data, this is the unit for which data is recorded.

Periodic survey: surveys that are usually part of the national survey programme, carried out regularly and with defined periodicity (annually, quarterly, etc.).

Population: A target population is the population outlined in the survey objects about which information is to be sought; a survey population is the population from which information can be obtained in the survey. In livestock statistics, the population can be all animals from one livestock type (for example, cattle) in the country or all ag-ricultural holdings breeding livestock in the country. Poultry: domesticated fowls used for meat and egg produc-tion that include chickens, turkeys, geese and ducks.

Proportional piling technique: a technique used for focus group questions, in which the groups are asked to ar-range a series of counters to indicate the relative importance of different factors to the question (for example, a group may use proportional piling to indicate the proportion of milk produced by the community's livestock for each month of the year).

Proxy measurement: estimated measurement of the item or object the researcher is seeking to collect data on by measuring a proxy item that has been proven to have a reliable relationship to the item of interest (for ex-ample, estimating the weight of livestock by measuring livestock girth, using pre-determined calculations based on test data to estimate the likely weight of each animal from its girth measure).

Random sampling (also called SRS): a process where a selected number of individuals (a sample) are chosen to participate in a survey from among a larger number of individuals (a population), and are assumed therefore to be representative of the likely response of the population.

Respondent: businesses, authorities, individual persons, etc., from whom data and associated information are collected for use in compiling statistics.

Recall survey: a face-to-face or paper-based questionnaire in which participants (respondents) are asked to an-swer specific questions by recalling information on past events or experiences.

Sample size: a specific number of observations chosen by researchers to include in a statistical sample, with the goal of making inferences about the total population through analysis of survey results or measurement from the sample.

Small ruminant/small stocks: domesticated mammals used for food, fibre and milk production that include sheep, goats, and deer.

Statistical unit: According to the UN, this is "an object of statistical survey and the bearer of statistical character-istics. The statistical unit is the basic unit of statistical observation within a statistical survey". In agricultural sur-veys, the statistical unit is usually the agricultural holding.

Annex 1

Livestock section of the AGRIS Core Module[1]

1 The full version of the questionnaire is available at: http://gsars.org/en/agris-handbook-on-the-agricultural-integrated-survey/#more-3641 (Handbook on the Agricultural Integrated Survey (AGRIS), pp. 70-87)

SECTION 4: LIVESTOCK PRODUCTION DURING THE REFERENCE PERIOD DD/MM/YYYY to DD/MM/YYYY

PART 4.1: RAISING ACTIVITIES AND PRODUCTION

TEXT TO READ:
This section of the questionnaire is about livestock and poultry on the holding.
Report for all animals on the holding, regardless of ownership, including those that are boarded (animals in pension), owned by another member of the household, custom-fed or fed under contract.

Q01. Do you register the main events about the livestock you raise (births, sales, production, etc.)?
- ◯ 0 No → **Please give the best estimations you can to the following questions.**
- ◯ 1 Yes

PART 4.1.1: EQUINE LIVESTOCK

Q02. Were equines raised on the holding during the reference period (12 months)?
- ◯ 0 No → **Go to Q08.**
- ◯ 1 Yes

Q02a What equines were raised on the holding during the reference period?

(Fill in all that apply) *RESPONSE = [EQUINE]*
- ◯ 1 Saddle or racing mares
- ◯ 2 Other mares
- ◯ 3 Saddle or racing horses (excluding mares)
- ◯ 4 Other horses (excluding mares)
- ◯ 5 Mules or hinnies
- ◯ 6 Asses
- ◯ 7 Other equines (specify ☐)

THE FOLLOWING QUESTIONS (Q03 to Q07) WILL BE ASKED FOR EACH OF THE EQUINE TYPES IDENTIFIED IN Q02a.

Q03. Answer the following questions about [EQUINE].

		Number of animals
Q03a	Number of [EQUINE] as of today	☐☐☐☐☐☐

Q04. Answer the following questions about the changes in [EQUINE] numbers during the reference period (12 months).

		Number of animals	Unit price of the last sale	Unit of measure
Q04a	Number of births (for young EQUINE only)	☐☐☐☐☐☐		
Q04b	Number of live animals bought or received (including exchanged)	☐☐☐☐☐☐		
Q04c	Number of animal deaths (from natural causes, illness, etc.)	☐☐☐☐☐☐		
Q04d	Number of live animals sold, used as pay or wages for labour, given to landlord as rent, given for other reasons, exchanged	☐☐☐☐☐☐	☐☐☐☐☐.☐☐	☐☐☐☐☐☐☐☐☐☐

Q05. Answer the following questions about the production of meat from [EQUINE] during the reference period (12 months).

Q05a Were any [EQUINE] slaughtered for meat **on the holding** during the reference period (12 months)?
- ◯ 0 No → **Go to Q05d.**
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q05b	Answer the following about [EQUINE] slaughtered on the holding.	☐☐☐☐☐☐	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐☐☐

Q05c Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q05d Were any [EQUINE] slaughtered for meat **in a slaughterhouse** for the holding during the reference period (12 months)?
- ◯ 0 No → **Go to Q06.**
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q05e	Answer the following about [EQUINE] slaughtered in a slaughterhouse.	☐☐☐☐☐☐	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐☐☐

Q05f Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q06. Answer the following questions about the destinations of the holding's production of [EQUINE] meat during the reference period - slaughtered on the holding or in a slaughterhouse

*** Use the same unit of measure that was reported for quantities in previous questions.**

		Quantity	Unit price of sale	Unit used to describe the price
Q06a	What was the quantity of [EQUINE] meat for own-use ?	☐☐☐☐☐.☐☐		
Q06b	What was the quantity of [EQUINE] meat sold?	☐☐☐☐☐.☐☐	☐☐☐☐☐.☐☐	☐☐☐☐☐☐☐☐☐☐
Q06c	What was the quantity of [EQUINE] meat used as pay for labour as wages?	☐☐☐☐☐.☐☐		
Q06d	What was the quantity of [EQUINE] meat given to service or input providers (in payment for feed, veterinary products, etc.) ?	☐☐☐☐☐.☐☐		

		Number of animals
Q07.	What is the number of [EQUINE] used for traction or draught purposes?	☐☐☐☐☐☐

PART 4.1.2: BOVINE CATTLE

Q08. Were bovine cattle raised on the holding during the reference period (12 months)?
- ◯ 0 No → **Go to Q21.**
- ◯ 1 Yes

Q08a What cattle were raised on the holding during the reference period?

(Fill in all that apply) *RESPONSE = [CATTLE]*
- ◯ 1 Dairy cows
- ◯ 2 Other cows
- ◯ 3 Cattle less than one year old
- ◯ 4 Other cattle (bulls, etc.)

THE FOLLOWING QUESTIONS (Q09 to Q13) WILL BE ASKED FOR EACH OF THE CATTLE TYPES IDENTIFIED IN Q08a.

Q09. Answer the following questions about [CATTLE].

		Number of animals
Q09a	Number of [CATTLE] as of today	

Q10. Answer the following questions about the changes in [CATTLE] numbers during the reference period (12 months).

		Number of animals	Unit price of the last sale	Unit of measure
Q10a	Number of births (for Q08a = 3)			
Q10b	Number of live animals bought or received (including exchanged)			
Q10c	Number of animal deaths (from natural causes, illness, etc.)			
Q10d	Number of live animals sold, used as pay or wages for labour, given to landlord as rent, given for other reasons, exchanged			

Q11. Answer the following questions about the production of meat from [CATTLE] during the reference period (12 months).

Q11a Were any [CATTLE] slaughtered for meat **on the holding** during the reference period (12 months)?
- ◯ 0 No → **Go to Q11d.**
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q11b	Answer the following about [CATTLE] slaughtered on the holding.			

Q11c Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q11d Were any [CATTLE] slaughtered for meat **in a slaughterhouse** for the holding during the reference period (12 months)?
- ◯ 0 No → **Go to Q12.**
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q11e	Answer the following about [CATTLE] slaughtered in a slaughterhouse.			

Q11f Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q12. Answer the following questions about the destinations of the holding's production of [CATTLE] meat during the reference period - slaughtered on the holding or in a slaughterhouse

*** Use the same unit of measure that was reported for quantities in previous questions.**

		Quantity	Unit price of sale	Unit used to describe the price
Q12a	What was the quantity of [CATTLE] meat for own use ?			
Q12b	What was the quantity of [CATTLE] meat sold?			
Q12c	What was the quantity of [CATTLE] meat used as pay for labour as wages?			
Q12d	What was the quantity of [CATTLE] meat given to service or input providers (in payment for feed, veterinary products, etc.)?			

FOR THOSE THAT REPORTED FEMALES Q08a=1, 2, ASK Q13.

Q13. Are any cows in lactation now?
- ◯ 0 No → **Go to Q15.**
- ◯ 1 Yes

Q13a. How many cows are in lactation ? ☐☐☐

Q14. When did the lactation period start? Y Y Y Y / M M / D D

Q15. What is the average period of time during the year in which you can get milk from a lactating female? (Include all lactation periods)

Q15a What is the time unit?

(Fill in one circle only)
- ◯ 1 Day
- ◯ 2 Week
- ◯ 3 Month

Q15b What is the number of time units per year for which you can get milk from a lactating female? ☐☐☐ per year

Q16. Do you allow calves to suckle directly from a cow?

(Fill in all that apply)
- ◯ 0 No
- ◯ 1 Yes, with the mother or with a suckler cow

Q17. For milk production, what is the period for which you prefer to answer questions?
*** The period selected will be used to answer a number of questions on milk production.**

(Fill in one circle only)
- ◯ 1 Daily average on a typical day
- ◯ 2 Yesterday (if the cows are in lactation)
- ◯ 3 Last week (if the cows are in lactation)
- ◯ 4 The reference period (12 months)

Q18. What was the production of raw milk in the period selected above? . . . . **Quantity of raw milk** ☐☐☐☐☐☐☐☐.☐ **Unit of measure** ☐☐☐☐☐☐☐☐☐☐☐☐

Q19. Report the share of milk used in the following ways:

		Percent
Q19a	Own use for human consumption	☐☐☐ %
Q19b	Processed on the holding into milk products	☐☐☐ %
Q19c	Given to young animals	☐☐☐ %
Q19d	Sold as raw milk	☐☐☐ %
Q19e	Other (specify ☐☐☐☐☐☐☐☐☐☐) . .	☐☐☐ %
	Total	1 0 0 %

Q19f If the share of raw milk sold (Q19d) is greater than 0%, answer the following about the milk sold. **Unit price of the last sale** ☐☐☐☐☐.☐☐ **Unit of measure** ☐☐☐☐☐☐☐☐☐☐☐☐

Q20. What is the number of [CATTLE] used for traction or draught purposes? . . . **Number of animals** ☐☐☐☐☐☐

PART 4.1.3: BUFFALOES

Q21. Were buffaloes raised on the holding during the reference period (12 months)?
- ◯ 0 No → **Go to Q34.**
- ◯ 1 Yes

Q21a What buffaloes were raised on the holding during the reference period?

(Fill in all that apply) *RESPONSE = [BUFFALO]*
- ◯ 1 Dairy females
- ◯ 2 Other females
- ◯ 3 Buffaloes less than one year old
- ◯ 4 Other buffaloes (bulls, etc.)

THE FOLLOWING QUESTIONS (Q22 to Q26) WILL BE ASKED FOR EACH OF THE BUFFALO TYPES IDENTIFIED IN Q21a.

Q22. Answer the following questions about [BUFFALO].

		Number of animals
Q22a	Number of [BUFFALO] as of today	

Q23. Answer the following questions about the changes in [BUFFALO] numbers during the reference period (12 months).

		Number of animals	Unit price of the last sale	Unit of measure
Q23a	Number of births (for Q21a = 3)			
Q23b	Number of live animals bought or received (including exchanged)			
Q23c	Number of animal deaths (from natural causes, illness, etc.)			
Q23d	Number of live animals sold, used as pay or wages for labour, given to landlord as rent, given for other reasons, exchanged			

Q24. Answer the following questions about the production of meat from [BUFFALO] during the reference period (12 months).

Q24a Were any [BUFFALO] slaughtered for meat **on the holding** during the reference period (12 months)?
- ◯ 0 No → **Go to Q24d.**
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q24b	Answer the following about [BUFFALO] slaughtered on the holding.			

Q24c Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q24d Were any [BUFFALO] slaughtered for meat **in a slaughterhouse** for the holding during the reference period (12 months)?
- ◯ 0 No → **Go to Q25.**
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q24e	Answer the following about [BUFFALO] slaughtered in a slaughterhouse.			

Q24f Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q25. Answer the following questions about the destinations of the holding's production of [BUFFALO] meat during the reference period - slaughtered on the holding or in a slaughterhouse

*** Use the same unit of measure that was reported for quantities in previous questions.**

		Quantity	Unit price of sale	Unit used to describe the price
Q25a	What was the quantity of [BUFFALO] meat for own use ?			
Q25b	What was the quantity of [BUFFALO] meat sold?			
Q25c	What was the quantity of [BUFFALO] meat used as pay for labour as wages			
Q25d	What was the quantity of [BUFFALO] meat given to service or input providers (in payment for feed, veterinary products, etc.)?			

FOR THOSE THAT REPORTED FEMALES Q21a=1, 2, ASK Q26.

Q26. Are buffalo females in lactation now?
- ◯ 0 No → **Go to Q28.**
- ◯ 1 Yes

Q26a. How many buffalo females are in lactation ? ☐☐☐

Q27. When did the lactation period start? Y Y Y Y / M M / D D ☐☐☐☐ / ☐☐ / ☐☐

Q28. What is the average period of time during the year in which you can get milk from a lactating female? (Include all lactation periods)

Q28a What is the time unit?

(Fill in one circle only)
- ◯ 1 Day
- ◯ 2 Week
- ◯ 3 Month

Q28b What is the number of time units per year for which you can get milk from a lactating female? ☐☐☐ per year

Q29. Do you allow young buffaloes to suckle directly from a female?

(Fill in all that apply)
- ◯ 0 No
- ◯ 1 Yes, with the mother or with a suckler buffalo female

Q30. For milk production, what is the period for which you prefer to answer questions?
*** The period selected will be used to answer a number of questions on milk production.**

- ◯ 1 Daily average on a typical day
- ◯ 2 Yesterday (if lactation is ongoing)
- ◯ 3 Last week (if lactation is ongoing)
- ◯ 4 The reference period (12 months)

Q31. What was the production of raw milk in the period selected above? . . . . **Quantity of raw milk** [ ][ ][ ][ ][ ][ ][ ][ ] . [ ] **Unit of measure** [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Q32. Report the share of milk used in the following ways:

		Percent
Q32a	Own use for human consumption	[ ][ ][ ] %
Q32b	Processed on the holding into milk products	[ ][ ][ ] %
Q32c	Given to young animals	[ ][ ][ ] %
Q32d	Sold as raw milk	[ ][ ][ ] %
	Total	[1][0][0] %

Q32e If the share of raw milk sold (Q32d) is greater than 0%, answer the following about the milk sold. **Unit price of the last sale** [ ][ ][ ][ ][ ][.][ ][ ] . **Unit of measure** [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Q33. What is the number of [BUFFALO] used for traction or draught purposes? . . . **Number of animals** [ ][ ][ ][ ][ ][ ]

PART 4.1.4: CAMELS AND CAMELIDS

Q34. Were camels or camelids raised on the holding during the reference period (12 months)?
- ◯ 0 No → **Go to Q47.**
- ◯ 1 Yes

Q34a What camelids were raised on the holding during the reference period?

(Fill in all that apply) *RESPONSE = [CAMELID]*
- ◯ 1 Camels
- ◯ 2 Llamas or vicugnas
- ◯ 3 Other camels and camelids (specify ☐)

THE FOLLOWING QUESTIONS (Q35 to Q46) WILL BE ASKED FOR EACH OF THE CAMELID TYPES IDENTIFIED IN Q34a.

Q35. Answer the following questions about [CAMELID].

	Number of animals
Q35a Number of [CAMELID] as of today	☐☐☐☐☐

Q36. Answer the following questions about the changes in [CAMELID] numbers during the reference period (12 months).

	Number of animals	Unit price of the last sale	Unit of measure
Q36a Number of births	☐☐☐☐☐		
Q36b Number of live animals bought or received (including exchanged)	☐☐☐☐☐		
Q36c Number of animal deaths (from natural causes, illness, etc.)	☐☐☐☐☐		
Q36d Number of live animals sold, used as pay or wages for labour, given to landlord as rent, given for other reasons, exchanged	☐☐☐☐☐	☐☐☐☐.☐☐	☐☐☐☐☐☐☐☐☐☐

Q37. Answer the following questions about the production of meat from [CAMELID] during the reference period (12 months).

Q37a Were any [CAMELID] slaughtered for meat **on the holding** during the reference period (12 months)?
- ◯ 0 No → **Go to Q37d.**
- ◯ 1 Yes

	Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q37b Answer the following about [CAMELID] slaughtered on the holding.	☐☐☐☐☐	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐☐☐

Q37c Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q37d Were any [CAMELID] slaughtered for meat **in a slaughterhouse** for the holding during the reference period (12 months)?
- ◯ 0 No → **Go to Q38.**
- ◯ 1 Yes

	Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q37e Answer the following about [CAMELID] slaughtered in a slaughterhouse.	☐☐☐☐☐	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐☐☐

Q37f Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q38. Answer the following questions about the destinations of the holding's production of [CAMELID] meat during the reference period - slaughtered on the holding or in a slaughterhouse

*** Use the same unit of measure that was reported for quantities in previous questions.**

	Quantity	Unit price of sale	Unit used to describe the price
Q38a What was the quantity of [CAMELID] meat for own-use ?	☐☐☐☐☐.☐☐		
Q38b What was the quantity of [CAMELID] meat sold?	☐☐☐☐☐.☐☐	☐☐☐☐.☐☐	☐☐☐☐☐☐☐☐☐☐
Q38c What was the quantity of [CAMELID] meat used as pay for labour as wages?	☐☐☐☐☐.☐☐		
Q38d What was the quantity of [CAMELID] meat given to service or input providers (in payment for feed, veterinary products, etc.)?	☐☐☐☐☐.☐☐		

Q39. Are any [CAMELID] females in lactation now?
- ◯ 0 No → **Go to Q41.**
- ◯ 1 Yes

Q39a. How many [CAMELID] females are in lactation ? ☐☐☐

Q40. When did the lactation period start? Y Y Y Y / M M / D D ☐☐☐☐ / ☐☐ / ☐☐

Q41. What is the average period of time during the year in which you can get milk from a lactating female? (Include all lactation periods)

Q41a What is the time unit?

(Fill in one circle only)
- ◯ 1 Day
- ◯ 2 Week
- ◯ 3 Month

Q41b What is the number of time units per year for which you can get milk from a lactating female? ☐☐☐ per year

Q42. Do you allow young [CAMELID] to suckle directly from a female?

(Fill in all that apply)
- ◯ 0 No
- ◯ 1 Yes, with the mother or with a suckler [CAMELID] female

Q43. For milk production, what is the period for which you prefer to answer questions?
*** The period selected will be used to answer a number of questions on milk production.**

(Fill in one circle only)
- ◯ 1 Daily average on a typical day
- ◯ 2 Yesterday (if lactation is ongoing)
- ◯ 3 Last week (if if lactation is ongoing)
- ◯ 4 The reference period (12 months)

Q44. What was the production of raw milk in the period selected above? . . . . **Quantity of raw milk** ☐☐☐☐☐☐☐☐.☐☐ **Unit of measure** ☐☐☐☐☐☐☐☐☐☐☐☐

Q45. Report the share of milk used in the following ways.

		Percent
Q45a	Own use for human consumption	☐☐☐ %
Q45b	Processed on the holding into milk products	☐☐☐ %
Q45c	Given to young animals	☐☐☐ %
Q45d	Sold as raw milk	☐☐☐ %
Q45e	Other (specify ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐) . .	☐☐☐ %
	Total	1 0 0 %

Q45f If the share of raw milk sold (Q45d) is greater than 0%, answer the following about the milk sold. **Unit price of the last sale** ☐☐☐☐☐.☐☐ **Unit of measure** ☐☐☐☐☐☐☐☐☐☐☐☐

Q46. What is the number of [CAMELID] used for traction or draught purposes? . . . **Number of animals** ☐☐☐☐☐☐

Q43. For milk production, what is the period for which you prefer to answer questions?
*** The period selected will be used to answer a number of questions on milk production.**

(Fill in one circle only)
- ◯ 1 Daily average on a typical day
- ◯ 2 Yesterday (if lactation is ongoing)
- ◯ 3 Last week (if if lactation is ongoing)
- ◯ 4 The reference period (12 months)

Q44. What was the production of raw milk in the period selected above? . . . . **Quantity of raw milk** ☐☐☐☐☐☐☐.☐ **Unit of measure** ☐☐☐☐☐☐☐☐☐☐

Q45. Report the share of milk used in the following ways.

		Percent
Q45a	Own use for human consumption	☐☐☐ %
Q45b	Processed on the holding into milk products	☐☐☐ %
Q45c	Given to young animals	☐☐☐ %
Q45d	Sold as raw milk	☐☐☐ %
Q45e	Other (specify ☐☐☐☐☐☐☐☐☐☐) . .	☐☐☐ %
	Total	1 0 0 %

Q45f If the share of raw milk sold (Q45d) is greater than 0%, answer the following about the milk sold. **Unit price of the last sale** ☐☐☐☐☐.☐☐ **Unit of measure** ☐☐☐☐☐☐☐☐☐☐

Q46. What is the number of [CAMELID] used for traction or draught purposes? . . . **Number of animals** ☐☐☐☐☐☐

PART 4.1.5: SHEEP

PLEASE NOTE THAT FOR THIS PART THE REFERENCE PERIOD IS 6 MONTHS

Q47. Were sheep raised on the holding during the reference period **(6 months)**?
- ◯ 0 No → Go to Q59.
- ◯ 1 Yes

Q47a What sheep were raised on the holding during the reference period?

(Fill in all that apply) *RESPONSE = [SHEEP]*
- ◯ 1 Dairy females
- ◯ 2 Other females
- ◯ 3 Sheep less than one year old
- ◯ 4 Other sheep (rams, etc.)

THE FOLLOWING QUESTIONS (Q48 to Q51) WILL BE ASKED FOR EACH OF THE SHEEP TYPES IDENTIFIED IN Q47a.

Q48. Answer the following questions about [SHEEP].

	Number of animals
Q48a Number of [SHEEP] as of today	

Q49. Answer the following questions about the changes in [SHEEP] numbers during the reference period (6 months).

	Number of animals	Unit price of the last sale	Unit of measure
Q49a Number of births (for Q47a = 3)			
Q49b Number of live animals bought or received (including exchanged)			
Q49c Number of animal deaths (from natural causes, illness, etc.)			
Q49d Number of live animals sold, used as pay or wages for labour, given to landlord as rent, given for other reasons, exchanged			

Q50. Answer the following questions about the production of meat from [SHEEP] during the reference period (6 months).

Q50a Were there any [SHEEP] slaughtered for meat **on the holding** during the reference period (6 months)?
- ◯ 0 No → Go to Q50d.
- ◯ 1 Yes

	Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q50b Answer the following about [SHEEP] slaughtered on the holding.			

Q50c Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q50d Were there any [SHEEP] slaughtered for meat **in a slaughterhouse** for the holding during the reference period (6 months)?
- ◯ 0 No → Go to Q50g.
- ◯ 1 Yes

	Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q50e Answer the following about [SHEEP] slaughtered in a slaughterhouse.			

Q50f Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q50g How is the production compared to the first 6 months of the reference period?

(Fill in one circle only)
- ◯ 1 Similar
- ◯ 2 Greater
- ◯ 3 Lower

Q51. Answer the following questions about the destinations of the holding's production of [SHEEP] meat during the reference period - slaughtered on the holding or in a slaughterhouse

*** Use the same unit of measure that was reported for quantities in previous questions.**

	Quantity	Unit price of sale	Unit used to describe the price
Q51a What was the quantity of [SHEEP] meat for own-use ?			
Q51b What was the quantity of [SHEEP] meat sold?			
Q51c What was the quantity of [SHEEP] meat used as pay for labour as wages?			
Q51d What was the quantity of [SHEEP] meat given to service or input providers (in payment for feed, veterinary products, etc.)?			

FOR THOSE THAT REPORTED FEMALES Q47a=1, 2, ASK Q52.

Q52. Are any sheep females in lactation now?
- ◯ 0 No → Go to Q54.
- ◯ 1 Yes

Q52a. How many sheep females are in lactation? ☐☐☐

Q53. When did the lactation period start? Y Y Y Y / M M / D D ☐☐☐☐ / ☐☐ / ☐☐

Q54. What is the average period of time during the year in which you can get milk from a lactating female? (Include all lactation periods)

Q54a What is the time unit?
(Fill in one circle only)
- ◯ 1 Day
- ◯ 2 Week
- ◯ 3 Month

Q54b What is the number of time units per year for which you can get milk from a lactating female? . . ☐☐☐ per year

Q55. Do you allow lambs to suckle directly from a female?

(Fill in all that apply)
- ◯ 0 No
- ◯ 1 Yes, with the mother or with a suckler sheep

Q56. For sheep milk production, what is the period for which you prefer to answer questions?
*** The period selected will be used to answer a number of questions on milk production.**

(Fill in one circle only)
- ◯ 1 Daily average on a typical day
- ◯ 2 Yesterday (if we are in a lactation period)
- ◯ 3 Last week (if we are in a lactation period)
- ◯ 4 Six months
- ◯ 5 Twelve months

Q57. What was the production of raw sheep milk in the period selected above? . . . **Quantity of raw milk** ☐☐☐☐☐☐☐☐. . **Unit of measure** ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Q58. Report the share of milk used in the following ways.

		Percent
Q58a	Own use for human consumption	☐☐☐ %
Q58b	Processed on the holding into milk products	☐☐☐ %
Q58c	Given to young animals	☐☐☐ %
Q58d	Sold as raw milk	☐☐☐ %
Q58e	Other (specify ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐)	☐☐☐ %
	Total	1 0 0 %

Q58f If the share of raw milk sold (Q58d) is greater than 0%, answer the following about the milk sold. **Unit price of the last sale** ☐☐☐☐☐.☐☐ **Unit of measure** ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

PART 4.1.6 GOATS

PLEASE NOTE THAT FOR THIS PART THE REFERENCE PERIOD IS 6 MONTHS

Q59. Were goats raised on the holding during the reference period (6 months)?
- ◯ 0 No → Go to Q71.
- ◯ 1 Yes

Q59a What goats were raised on the holding during the reference period?

(Fill in all that apply) *RESPONSE = [GOAT]*
- ◯ 1 Dairy females
- ◯ 2 Other females
- ◯ 3 Goats less than one year old
- ◯ 4 Other goats (bucks, etc.)

THE FOLLOWING QUESTIONS (Q60 to Q63) WILL BE ASKED FOR EACH OF THE GOAT TYPES IDENTIFIED IN Q59a.

Q60. Answer the following questions about [GOAT].

		Number of animals
Q60a	Number of [GOAT] as of today	

Q61. Answer the following questions about the changes in [GOAT] numbers during the reference period (6 months).

		Number of animals	Unit price of the last sale	Unit of measure
Q61a	Number of births (for Q59a = 3)			
Q61b	Number of live animals bought or received (including exchanged)			
Q61c	Number of animal deaths (from natural causes, illness, etc.)			
Q61d	Number of live animals sold, used as pay or wages for labour, given to landlord as rent, given for other reasons, exchanged			

Q62. Answer the following questions about the production of meat from [GOAT] during the reference period (6 months).

Q62a Were any [GOAT] slaughtered for meat **on the holding** during the reference period (6 months)?
- ◯ 0 No → Go to Q62d.
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q62b	Answer the following about [GOAT] slaughtered on the holding.			

Q62c Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q62d Were any [GOAT] slaughtered for meat **in a slaughterhouse** for the holding during the reference period (6 months)?
- ◯ 0 No → Go to Q62g.
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q62e	Answer the following about [GOAT] slaughtered in a slaughterhouse.			

Q62f Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q62g How is the production compared to the first 6 months of the reference period?

(Fill in one circle only)
- ◯ 1 Similar
- ◯ 2 Greater
- ◯ 3 Lower

Q63. Answer the following questions about the destinations of the holding's production of [GOAT] meat during the reference period - slaughtered on the holding or in a slaughterhouse

*** Use the same unit of measure that was reported for quantities in previous questions.**

		Quantity	Unit price of sale	Unit used to describe the price
Q63a	What was the quantity of [GOAT] meat for own-use ?			
Q63b	What was the quantity of [GOAT] meat sold.			
Q63c	What was the quantity of [GOAT] meat used as pay for labour as wages			
Q63d	What was the quantity of [GOAT] meat given to service or input providers (in payment for feed, veterinary products, etc.)			

FOR THOSE THAT REPORTED FEMALES Q59a=1, 2, ASK Q64.

Q64. Are any goat females in lactation now?
- ◯ 0 No → Go to Q66.
- ◯ 1 Yes

Q64a. How many goat females are in lactation ? ☐☐☐

Q65. When did the lactation period start? Y Y Y Y / M M / D D ☐☐☐☐ / ☐☐ / ☐☐

Q66. What is the average period of time during the year in which you can get milk from a lactating female? (Include all lactation periods)

Q66a What is the time unit?

(Fill in one circle only)
- ◯ 1 Day
- ◯ 2 Week
- ◯ 3 Month

Q66b What is the number of time units per year for which you can get milk from a lactating female? . . ☐☐☐ per year

Q67. Do you allow kids to suckle directly from a female?

(Fill in all that apply)
- ◯ 0 No
- ◯ 1 Yes, with the mother or with a suckler goat

Q68. For milk production, what is the period for which you prefer to answer questions?
*** The period selected will be used to answer a number of questions on milk production.**

(Fill in one circle only)
- ◯ 1 Daily average on a typical day
- ◯ 2 Yesterday (if lactation is ongoing)
- ◯ 3 Last week (if lactation is ongoing)
- ◯ 4 Six months
- ◯ 5 Twelve months

Q69. What was the production of raw milk in the period selected above? . . . . **Quantity of raw milk** ☐☐☐☐☐☐☐☐. . **Unit of measure** ☐☐☐☐☐☐☐☐☐☐☐☐

Q70. Report the share of milk used in the following ways:

		Percent
Q70a	Own use for human consumption	☐☐☐ %
Q70b	Processed on the holding into milk products	☐☐☐ %
Q70c	Given to young animals	☐☐☐ %
Q70d	Sold as raw milk	☐☐☐ %
Q70e	Other (specify ☐☐☐☐☐☐☐☐☐☐☐☐)	☐☐☐
	Total	1 0 0 %

Q70f If the share of raw milk sold (Q70d) is greater than 0%, answer the following about the milk sold. **Unit price of the last sale** ☐☐☐☐☐.☐☐. **Unit of measure** ☐☐☐☐☐☐☐☐☐☐☐☐

PART 4.1.7 OTHER RUMINANTS

Q71. Were other ruminants raised on the holding during the reference period (12 months)?
- ◯ 0 No → **Go to Q74.**
- ◯ 1 Yes

Q71a What other ruminants were raised on the holding during the reference period?

(Fill in all that apply) *RESPONSE = [OTHER RUMINANT]*
- ◯ 1 Species 1 (specify ☐☐☐☐☐☐☐☐☐☐☐☐)
- ◯ 2 Species 2 (specify ☐☐☐☐☐☐☐☐☐☐☐☐)
- ◯ 3 Species 3 (specify ☐☐☐☐☐☐☐☐☐☐☐☐)

THE FOLLOWING QUESTIONS (Q72 and Q73) WILL BE ASKED FOR EACH OF THE OTHER RUMINANT TYPES IDENTIFIED IN Q71a.

Q72. Answer the following questions about [OTHER RUMINANT].

Number of animals

Q72a Number of [OTHER RUMINANT] as of today . . . . . ☐☐☐☐☐☐

Q73. Answer the following questions about the changes in [OTHER RUMINANT] numbers during the reference period (12 months).

		Number of animals	Unit price of the last sale	Unit of measure
Q73a	Number of births	☐☐☐☐☐☐		
Q73b	Number of live animals bought or received (including exchanged) . .	☐☐☐☐☐☐		
Q73c	Number of animal deaths (from natural causes, illness, etc.)	☐☐☐☐☐☐		
Q73d	Number of live animals sold, used as pay or wages for labour, given to landlord as rent, given for other reasons, exchanged . .	☐☐☐☐☐☐. .	☐☐☐☐☐.☐☐. .	☐☐☐☐☐☐☐☐☐☐☐☐

PART 4.1.8 PIGS

PLEASE NOTE THAT FOR THIS PART THE REFERENCE PERIOD IS 6 MONTHS

Q74. Were pigs raised on the holding during the reference period (6 months)?
- ◯ 0 No → **Go to Q79.**
- ◯ 1 Yes

Q74a What pigs were raised on the holding during the reference period?

(Fill in all that apply) *RESPONSE = [PIG]*
- ◯ 1 Piglets
- ◯ 2 Breeding sows
- ◯ 3 Other pigs (boars, etc.)

THE FOLLOWING QUESTIONS (Q75 to Q78) WILL BE ASKED FOR EACH OF THE PIG TYPES IDENTIFIED IN Q74a.

Q75. Answer the following questions about [PIG].

		Number of animals
Q75a	Number of [PIG] as of today	

Q76. Answer the following questions about the changes in [PIG] numbers during the reference period (6 months).

		Number of animals	Unit price of the last sale	Unit of measure
Q76a	Number of births (for Q74a = 1)			
Q76b	Number of live animals bought or received (including exchanged)			
Q76c	Number of animal deaths (from natural causes, illness, etc.)			
Q76d	Number of live animals sold, used as pay or wages for labour, given to landlord as rent, given for other reasons, exchanged			

Q77. Answer the following questions about the production of meat from [PIG] during the reference period (6 months).

Q77a Were there any [PIG] slaughtered for meat **on the holding** during the reference period (6 months)?
- ◯ 0 No → **Go to Q77d.**
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q77b	Answer the following about [PIG] slaughtered on the holding.			

Q77c Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q77d Were there any [PIG] slaughtered for meat **in a slaughterhouse** for the holding during the reference period (6 months)?
- ◯ 0 No → **Go to Q77g.**
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q77e	Answer the following about [PIG] slaughtered in a slaughterhouse.			

Q77f Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q77g How is the production compared to the first 6 months of the reference period?

(Fill in one circle only)
- ◯ 1 Similar
- ◯ 2 Greater
- ◯ 3 Lower

Q78. Answer the following questions about the destinations of the holding's production of [PIG] meat during the reference period - slaughtered on the holding or in a slaughterhouse

*** Use the same unit of measure that was reported for quantities in previous questions.**

		Quantity	Unit price of sale	Unit used to describe the price
Q78a	What was the quantity of [PIG] meat for own-use ?			
Q78b	What was the quantity of [PIG] meat sold?			
Q78c	What was the quantity of [PIG] meat used as pay for labour as wages?			
Q78d	What was the quantity of [PIG] meat given to service or input providers (in payment for feed, veterinary products, etc.)?			

PART 4.1.9 RABBITS

PLEASE NOTE THAT FOR THIS PART THE REFERENCE PERIOD IS 3 MONTHS

Q79. Were rabbits raised on the holding during the reference period (3 months)?
- ◯ 0 No → **Go to Q84.**
- ◯ 1 Yes

Q79a What rabbits were raised on the holding during the reference period?

(Fill in all that apply) *RESPONSE = [RABBIT]*
- ◯ 1 Breeding females
- ◯ 2 All other rabbits

THE FOLLOWING QUESTIONS (Q80 to Q83) WILL BE ASKED FOR EACH OF THE RABBIT TYPES IDENTIFIED IN Q79a.

Q80. Answer the following questions about [RABBIT].

		Number of animals
Q80a	Number of [RABBIT] as of today	

Q81. Answer the following questions about the changes in [RABBIT] numbers during the reference period (3 months).

		Number of animals	Unit price of the last sale	Unit of measure
Q81a	Number of births (for Q79a = 2)			
Q81b	Number of live animals bought or received (including exchanged)			
Q81c	Number of animal deaths (from natural causes, illness, etc.)			
Q81d	Number of live animals sold, used as pay or wages for labour, given to landlord as rent, given for other reasons, exchanged			

Q82. Answer the following questions about the production of meat from [RABBIT] during the reference period (3 months).

Q82a Were any [RABBIT] slaughtered for meat **on the holding** during the reference period (3 months)?
- ◯ 0 No → **Go to Q82d.**
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q82b	Answer the following about [RABBIT] slaughtered on the holding.			

Q82c Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q82d Were any [RABBIT] slaughtered for meat **in a slaughterhouse** for the holding during the reference period (3 months)?
- ◯ 0 No → **Go to Q82g.**
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q82e	Answer the following about [RABBIT] slaughtered in a slaughterhouse.			

Q82f Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q82g How is the production compared to the other period of the reference year?

(Fill in one circle only)
- ◯ 1 Similar
- ◯ 2 Greater
- ◯ 3 Lower

Q83. Answer the following questions about the destinations of the holding's production of [RABBIT] meat during the reference period - slaughtered on the holding or in a slaughterhouse

*** Use the same unit of measure that was reported for quantities in previous questions.**

		Quantity	Unit price of sale	Unit used to describe the price
Q83a	What was the quantity of [RABBIT] meat for own-use ?			
Q83b	What was the quantity of [RABBIT] meat sold?			
Q83c	What was the quantity of [RABBIT] meat used as pay for labour as wages?			
Q83d	What was the quantity of [RABBIT] meat given to service or input providers (in payment for feed, veterinary products, etc.)?			

PART 4.1.10 POULTRY

PLEASE NOTE THAT FOR THIS PART THE REFERENCE PERIOD IS 3 MONTHS

Q84. Was poultry raised on the holding during the reference period (3 months)?
- ◯ 0 No → **Go to Q93.**
- ◯ 1 Yes

Q84a What poultry types were raised on the holding during the reference period?

(Fill in all that apply) *RESPONSE = [POULTRY]*
- ◯ 1 Broilers
- ◯ 2 Laying hens
- ◯ 3 All other chickens
- ◯ 4 Turkeys
- ◯ 5 Ducks
- ◯ 6 Geese
- ◯ 7 Guinea fowls
- ◯ 8 Pigeons
- ◯ 9 Ostriches or emus
- ◯ 10 Other poultry (specify ☐)

THE FOLLOWING QUESTIONS (Q85 to Q92) WILL BE ASKED FOR EACH OF THE POULTRY TYPES IDENTIFIED IN Q84a.

Q85. Answer the following questions about [POULTRY].

		Number of animals
Q85a	Number of [POULTRY] as of today	☐☐☐☐☐☐

Q86. Answer the following questions about the changes in [POULTRY] numbers during the reference period (3 months).

		Number of animals	Unit price of the last sale	Unit of measure
Q86a	Number of births (without Q84a = 2)	☐☐☐☐☐☐		
Q86b	Number of live animals bought or received (including exchanged)	☐☐☐☐☐☐		
Q86c	Number of animal deaths (from natural causes, illness, etc.)	☐☐☐☐☐☐		
Q86d	Number of live animals sold, used as pay or wages for labour, given to landlord as rent, given for other reasons, exchanged	☐☐☐☐☐☐	☐☐☐☐☐.☐☐	☐☐☐☐☐☐☐☐☐☐

NOTE - EXCLUDE LAYING HENS (Q84 =2) FROM Q87.

Q87. Answer the following questions about the production of meat from [POULTRY] during the reference period (3 months).

Q87a Were any [POULTRY] slaughtered for meat **on the holding** during the reference period (3 months)?
- ◯ 0 No → **Go to Q87d.**
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q87b	Answer the following about [POULTRY] slaughtered on the holding.	☐☐☐☐☐☐	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐☐☐

Q87c Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q87d Were any [POULTRY] slaughtered for meat **in a slaughterhouse** for the holding during the reference period (3 months)?
- ◯ 0 No → **Go to Q87g.**
- ◯ 1 Yes

		Number of animals slaughtered	Total carcass weight obtained	Unit of measure
Q87e	Answer the following about [POULTRY] slaughtered in a slaughterhouse.	☐☐☐☐☐☐	☐☐☐☐☐☐☐☐	☐☐☐☐☐☐☐☐☐☐

Q87f Is the carcass weight reported above measured or estimated?
- ◯ 1 Measured
- ◯ 2 Estimated

Q87g How is the production compared to the other period of the reference year?

(Fill in one circle only)
- ◯ 1 Similar
- ◯ 2 Greater
- ◯ 3 Lower

Q88. Answer the following questions about the destinations of the holding's production of [POULTRY] meat during the reference period - slaughtered on the holding or in a slaughterhouse

*** Use the same unit of measure that was reported for quantities in previous questions.**

		Quantity	Unit price of sale	Unit used to describe the price
Q88a	What was the quantity of [POULTRY] meat for own-use ?	☐☐☐☐☐.☐☐		
Q88b	What was the quantity of [POULTRY] meat sold?	☐☐☐☐☐.☐☐	☐☐☐☐☐.☐☐	☐☐☐☐☐☐☐☐☐☐
Q88c	What was the quantity of [POULTRY] meat used as pay for labour as wages?	☐☐☐☐☐.☐☐		
Q88d	What was the quantity of [POULTRY] meat given to service or input providers (in payment for feed, veterinary products, etc.)?	☐☐☐☐☐.☐☐		

NOTE - EXCLUDE BROILERS (Q84 = 1) AND "ALL OTHER CHICKENS" (Q84= 3) FROM Q89.

Q89. What is the average number of days during the year for which you get eggs from a [POULTRY]? (Include all egg production periods) ☐☐☐ days per year

Q90. For egg production, what is the period for which you prefer to answer questions?
*** The period selected will be used to answer a number of questions on egg production.**

(Fill in one circle only)
- ◯ 1 Daily average on a typical day
- ◯ 2 Yesterday (if an egg production period is currently ongoing)
- ◯ 3 Last week (if an egg production period is currently ongoing)
- ◯ 4 Three months
- ◯ 5 Twelve months

Q91. What was the production of [POULTRY] eggs in the period selected above? . . Quantity ☐☐☐☐☐☐☐☐ . . Unit of measure ☐☐☐☐☐☐☐☐☐☐

Q92. Report the share of [POULTRY] eggs used in the following ways.

		Percent
Q92a	Own use for human consumption	☐☐☐ %
Q92b	Eggs used for renewal	☐☐☐ %
Q92c	Sold	☐☐☐ %
Q92d	Other (specify ☐☐☐☐☐☐☐☐)	☐☐☐ %
	Total	1 0 0 %

Q92e If the share of [POULTRY] eggs sold (Q92c) is greater than 0%, answer the following about the eggs sold. . . . . Unit price of the last sale ☐☐☐☐☐.☐☐ Unit of measure ☐☐☐☐☐☐☐☐☐☐

PART 4.1.11 INSECTS

Q93. Were insects raised on the holding during the reference period (12 months)?
- ◯ 0 No → **Go to Q98.**
- ◯ 1 Yes

Q93a What insect types were raised on the holding during the reference period?

(Fill in all that apply) *RESPONSE = [INSECT]*
- ◯ 1 (Country-specific option)
- ◯ 2 (Country-specific option)
- ◯ 3 (Country-specific option)
- ◯ 4 Other insects (specify ☐☐☐☐☐☐☐☐)

THE FOLLOWING QUESTIONS (Q94 to Q97) WILL BE ASKED FOR EACH OF THE INSECT TYPES IDENTIFIED IN Q93a.

Q94. Answer the following questions about [INSECT].

Q94a Volume or weight of [INSECT] as of today . . . . . Volume or weight ☐☐☐☐☐☐☐☐ . . . Unit of measure ☐☐☐☐☐☐☐☐☐☐

Q95. Answer the following questions about the changes in [INSECT] numbers during the reference period (12 months).
*** Use the same unit of measure as in Q94a above.**

		Volume or weight
Q95a	Volume or weight of insects propagated on the holding . . .	☐☐☐☐☐☐☐☐
Q95b	Volume or weight of live insects bought or received (including exchanged)	☐☐☐☐☐☐☐☐
Q95c	Volume or weight of insect deaths (from natural causes, illness, etc.) . .	☐☐☐☐☐☐☐☐
Q95d	Volume or weight of live insects sold, used as pay or wages for labour, given to landlord as rent, given for other reasons, exchanged . .	☐☐☐☐☐☐☐☐

Q96. What was the production of [INSECT] during the reference period? . . . . . Volume or weight ☐☐☐☐☐☐☐☐ . . . Unit of measure ☐☐☐☐☐☐☐☐☐☐

Q97. Report the share of [INSECT] used in the following ways.

		Percent
Q97a	Own use for human consumption	☐☐☐ %
Q97b	Insects processed on the holding	☐☐☐ %
Q97c	Sold insects	☐☐☐ %
	Total	**1 0 0 %**

Q97d If the share of [INSECT] sold (Q97c) is greater than 0%, answer the following about the production sold . . . . . Unit price of the last sale ☐☐☐☐☐.☐☐ Unit of measure ☐☐☐☐☐☐☐☐☐☐

ONCE COMPLETE FOR ALL INSECT TYPES, PROCEED TO PART 4.1.12

PART 4.1.12 OTHER ANIMALS AND ANIMAL PRODUCTS

Q98. Were honeybees raised on the holding during the reference period (12 months)?

◯ 0 No → Go to Q99.
◯ 1 Yes

Q98a Number of beehives in production in the holding . . . . . beehives

	Quantity	Unit of measure
Q98b Production of honey during the reference period		

Q99. Answer the following questions about other animals and animal products produced during the reference period (12 months).

	Produced?	Production during the reference period	Unit of measure (see codes)	Unit price used in the last sale	Unit of price measurement
Shorn wool	No ◯ Yes ◯ →				
Pulled wool	No ◯ Yes ◯ →				
Non-carded animal hair	No ◯ Yes ◯ →				
Silkworm cocoons	No ◯ Yes ◯ →				
Furs	No ◯ Yes ◯ →				
Animal skins	No ◯ Yes ◯ →				
Other (snails, frogs, etc.) (Specify..)	No ◯ Yes ◯ →				

PART 4.2: RAISING PRACTICES

THE SERIES OF QUESTIONS ON RAISING PRACTICES WILL BE ASKED FOR EACH OF THE LIVESTOCK TYPES IDENTIFIED THROUGHOUT SECTION 4. ONCE COMPLETE FOR ALL LIVESTOCK TYPES, PROCEED TO PART 4.3.

Q100. Identify the major feeding practices for the [LIVESTOCK] during the reference period (DD/MM/YYYY to DD/MM/YYYY)

(Fill in one circle only)

◯ 1 Only grazing
◯ 2 Mainly grazing, with some feeding
◯ 3 Mainly feeding, with some grazing
◯ 4 Only feeding

QUESTION Q101 IS TO BE ASKED IN THE FIRST CYCLE (FOR LIVESTOCK in general) ONLY.
THE ANSWER TO THIS QUESTION WILL DETERMINE IF Q101a ETC. WILL BE ASKED FOR LIVESTOCK1 AND SUBSEQUENT LIVESTOCK TYPES.

Q101 Does the holding have a production and/or marketing contract for, at least one livestock type?

◯ 0 No → Go to Q102.
◯ 1 Yes → Go to Q101a.

Q101a Does the holding have a production contract for [LIVESTOCK]?

◯ 0 No → Go to Q101c.
◯ 1 Yes → Go to Q101b.

Q101b Does the production contract cover 100% of the [LIVESTOCK] grown by the holding (exclusive contract)?

◯ 0 No
◯ 1 Yes

Q101c Does the holding have a marketing contract for [LIVESTOCK]?

◯ 0 No → Go to next livestock type or to Q102 after the last type.
◯ 1 Yes → Go to Q101d.

Q101d Does the marketing contract cover 100% of the [LIVESTOCK] grown by the holding (exclusive contract)?

◯ 0 No
◯ 1 Yes

PART 4.3: INTENTIONS FOR LIVESTOCK PRODUCTION FOR THE 12 MONTHS AFTER THE REFERENCE PERIOD

THE SERIES OF LIVESTOCK-RELATED QUESTIONS WILL BE ASKED FOR EACH OF THE LIVESTOCK TYPES IDENTIFIED THROUGHOUT SECTION 4. ONCE COMPLETE FOR ALL LIVESTOCK, PROCEED TO Q103.

Q102. Answer the following questions about production intentions for [LIVESTOCK].

Q102a How many head of [LIVESTOCK] do you plan to raise in the upcoming period?

(Fill in one circle only)

- ◯ 1 Similar → **Go to Q103.**
- ◯ 2 Greater → **Go to Q103.**
- ◯ 3 Lower → **Go to Q103.**
- ◯ 4 None → **Go to Q103.**

Q102b What is the main reason for changes in the number of [LIVESTOCK]?

(Fill in one circle only)

- ◯ 1 Technical
- ◯ 2 Economic
- ◯ 3 Other (specify ☐)

QUESTION Q103 IS TO BE ASKED IN THE LAST CYCLE OF [LIVESTOCK] ONLY.

Q103. Do you plan to begin raising other livestock in the upcoming period?

- ◯ 0 No → **Go to SECTION 5.**
- ◯ 1 Yes

Q103a What types of livestock do you plan to introduce in the upcoming period?

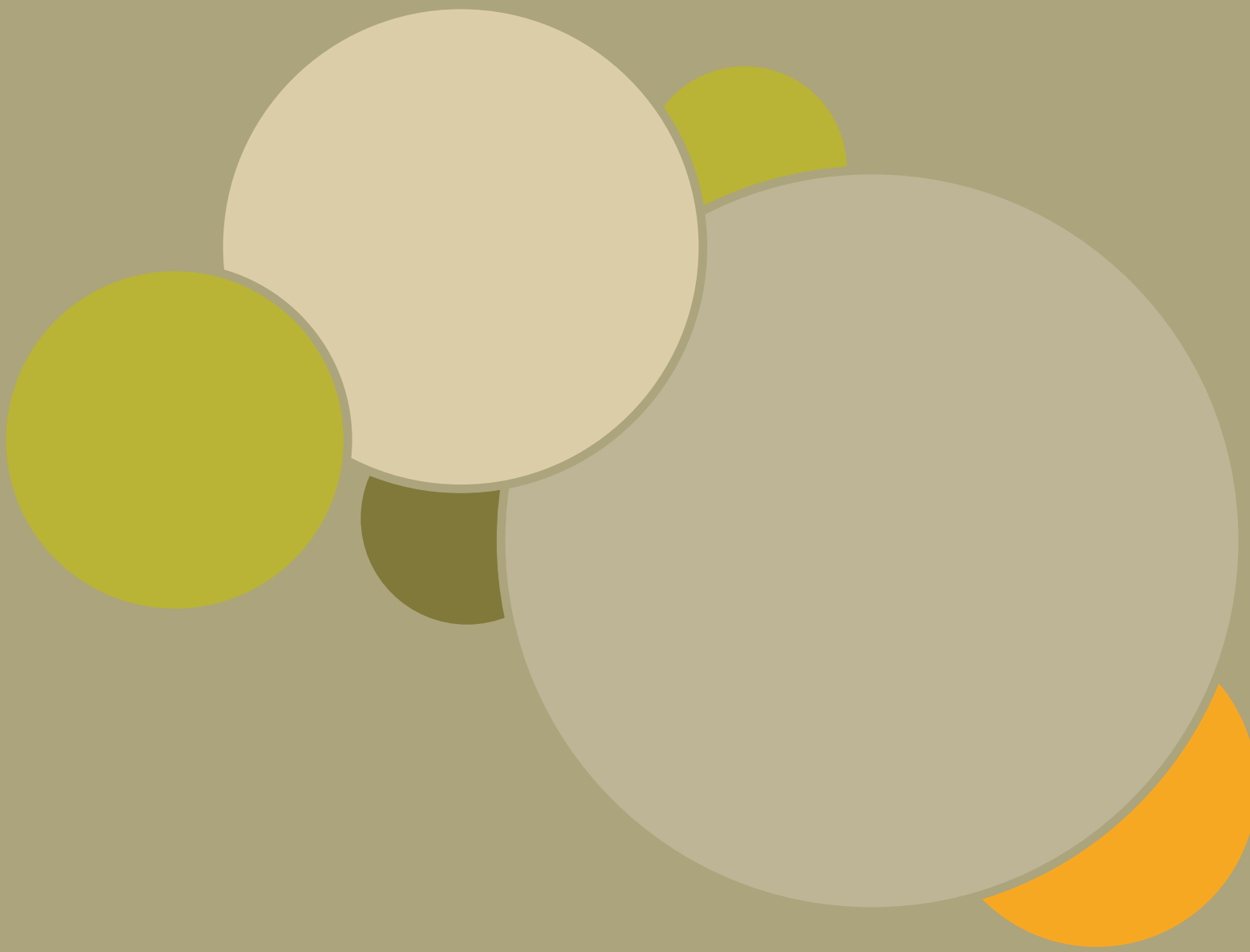
	Livestock type	**Livestock code**
[LIVESTOCK 1]	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐	☐☐☐☐☐
[LIVESTOCK 2]	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐	☐☐☐☐☐
[LIVESTOCK 3]	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐	☐☐☐☐☐
[LIVESTOCK 4]	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐	☐☐☐☐☐

Q103b What is the main reason for introducing [LIVESTOCK]?

(Fill in one circle only)

- ◯ 1 Technical
- ◯ 2 Economic
- ◯ 3 Other (specify ☐)

Comments on SECTION 4:



Annex 2

Livestock section of the AGRIS Production Methods and the Environment module[1]

1 The full version of the questionnaire is available at: http://gsars.org/en/agris-handbook-on-the-agricultural-integrated-survey/#more-3641 (Handbook on the Agricultural Integrated Survey (AGRIS), pp. 235-244)

SECTION 4: LIVESTOCK PRODUCTION METHODS DURING THE REFERENCE PERIOD (DD/MM/YYYY TO DD/MM/YYYY)

PART 4.1: ANIMAL BREEDING AND REPRODUCTION DURING THE REFERENCE PERIOD (DD/MM/YYYY) TO (DD/MM/YYYY).

Q01. Was livestock raised on the holding during the reference period?

- ◯ 0 No → Go to SECTION 5.
- ◯ 1 Yes

Q02. Identify the types of livestock raised on the holding during the reference period.

(fill in all that apply) *RESPONSE = [LIVESTOCK]* *RESPONSE = [DRAFT LIVESTOCK] for answers 1 to 4*

- ◯ 1 Equidae
- ◯ 2 Cattle
- ◯ 3 Buffaloes
- ◯ 4 Camelidae
- ◯ 5 Sheep
- ◯ 6 Goats
- ◯ 7 Pigs
- ◯ 8 Rabbits
- ◯ 9 Poultry
- ◯ 10 Insects
- ◯ 999 Other (specify ☐)

REPEAT Q03 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.

Q03. Identify the main animal reproduction technique for [LIVESTOCK] used on the holding during the reference period.

(fill in one circle only)

- ◯ 1 Natural mating with a sire selected within the herd
- ◯ 2 Natural mating with a purchased or rented sire
- ◯ 3 Natural mating with an exchanged sire
- ◯ 4 Artificial insemination
- ◯ 5 Dam was purchased pregnant
- ◯ 6 Dam was exchanged pregnant
- ◯ 999 Other (specify ☐)

CONTINUE Q03 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO Q04.

Q04. Identify the main provider of breeding services for the holding during the reference period.

(fill in one circle only)

- ◯ 1 Private veterinarian
- ◯ 2 Public veterinarian
- ◯ 3 Self-provision
- ◯ 999 Other (specify ☐)

PART 4.2: USE OF VETERINARY PRODUCTS AND TRADITIONAL METHODS DURING THE REFERENCE PERIOD (DD/MM/YYYY) TO (DD/MM/YYYY).

Q05. Were veterinary services used on the holding during the reference period?

- ◯ 0 No → Go to Q07.
- ◯ 1 Yes

REPEAT Q06 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.

Q06. Identify the types of veterinary services used by the holding for [LIVESTOCK] during the reference period.

(fill in all that apply)

- ◯ 1 Reproduction
- ◯ 2 Curative treatment, surgical procedures
- ◯ 3 Curative treatment, other (specify ☐)
- ◯ 4 Preventative medicine, vaccinations
- ◯ 5 Preventative medicine, deworming (anthelmintic)
- ◯ 6 Preventative medicine against parasites
- ◯ 7 Preventative medicine, other (specify ☐)

CONTINUE Q06 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO Q07.

Q07. Were hormones used on livestock on the holding during the reference period?

- ◯ 0 No → Go to Q09.
- ◯ 1 Yes

REPEAT Q08 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.

Q08. Identify the types of hormones used on [LIVESTOCK] during the reference period.

(fill in all that apply)

- ◯ 1 Hormone Type 1
- ◯ 2 Hormone Type 2
- ◯ 999 Other hormones (specify ☐)
- ◯ 0 None of the above

CONTINUE Q08 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO Q09.

Q09. Were antibiotics used on livestock on the holding during the reference period?

- ◯ 0 No → Go to Q11.
- ◯ 1 Yes

REPEAT Q10 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.

Q10. Identify the types of antibiotics used on [LIVESTOCK] during the reference period.

(fill in all that apply)

- ◯ 4 Antibiotic Type 1
- ◯ 5 Antibiotic Type 2
- ◯ 999 Other antibiotics (specify ☐)
- ◯ 0 None of the above

CONTINUE Q10 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO Q11.

Q11. Was traditional medicine applied on the livestock on the holding during the reference period?

- ◯ 0 No → Go to PART 4.3, Q13.
- ◯ 1 Yes

REPEAT Q12 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.

Q12. Identify the objectives of the traditional medicine applied on [LIVESTOCK] during the reference period.

(fill in all that apply)

- ◯ 1 Reproduction
- ◯ 2 Curative
- ◯ 3 Preventative
- ◯ 999 Other (specify ☐)
- ◯ 0 None of the above

CONTINUE Q12 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO PART 4.3, Q13.

PART 4.3: ANIMAL HOUSING DURING THE REFERENCE PERIOD (DD/MM/YYYY) TO (DD/MM/YYYY).

Q13 is to be asked in the following cases:
Where Q02 = 2 (cattle)
Where Q02 = 3 (buffaloes)
Q13 is to be asked separately for each of the cases outlined above.
If Q02 does not equal 2 and/or 3, Go to Q14.

Q13. Identify the main type of animal housing system that was used for [LIVESTOCK] on the holding during the reference period.

(fill in one circle only)
- ◯ 1 Open/no housing
- ◯ 2 Stanchion-tied stable, with solid dung or liquid manure/slurry
- ◯ 3 Loose housing, with solid dung or liquid manure/slurry
- ◯ 999 Other, including boxes sometimes used for young animals (specify ☐)

CONTINUE Q13 UNTIL ALL [LIVESTOCK] (CATTLE AND BUFFALOES) ARE COVERED, THEN PROCEED TO Q14.

Q14 is to be asked where Q02 = 7 (pigs); otherwise, Go to Q15.

Q14. Identify the main type of animal housing system that was used for pigs on the holding during the reference period.

(fill in one circle only)
- ◯ 1 Open/no housing
- ◯ 2 On partially or completely slatted floors
- ◯ 3 On straw-beds (deep litter loose housing)
- ◯ 999 Other (specify ☐)

Q15 is to be asked where Q02 = 5 (sheep) and/or 6 (goats). Where Q02 = 5 and/or 6; this becomes "small ruminants".
Q15 is to be asked only once for the combined category of Q02 = 5 and/or 6.
If Q02 does not equal 5 and/or 6, Go to Q16.

Q15. Identify the main type of animal housing system that was used for small ruminants on the holding during the reference period.

(fill in one circle only)
- ◯ 1 Open/no housing
- ◯ 2 Traditional barns or buildings
- ◯ 3 Shelter
- ◯ 999 Other (specify ☐)

Q16 is to be asked where Q02 = 9 (poultry)
If Q02 does not equal 9, Go to Q18.

Q16. Were chickens raised on this holding during the reference period?
*Include chickens raised for eggs and chicken raised for meat.

- ◯ 0 No → Go to Q18.
- ◯ 1 Yes

Q17. Identify the main type of animal housing system that was used for chickens on the holding during the reference period.

(fill in one circle only)
- ◯ 1 Open/no housing
- ◯ 2 On straw-beds (deep litter loose housing)
- ◯ 3 Battery cage with manure belt
- ◯ 4 Battery cage with deep pit
- ◯ 5 Battery cage with stilt house
- ◯ 999 Other (specify ☐)

Q18. Was any of the housing reported above used to house both humans and livestock?

- ◯ 0 No
- ◯ 1 Yes

Do not ask Q19 if Q13=1 and/or Q14=1 and/or Q15=1 and/or Q17=1 (that is, if livestock are held "open/no housing")

Q19. Identify the types of ventilation systems in the livestock building(s) on the holding during the reference period.

(fill in all that apply)
- ◯ 1 Fans switched on automatically
- ◯ 2 Fans switched on manually
- ◯ 3 Passive ventilation (side curtains, free air or vent panels)
- ◯ 999 Other (specify ☐)
- ◯ 0 None of the above

Q20 is to be asked where Q02 = 7 (pigs) and/or 9 (poultry).
If Q02 does not equal 7 and/or 9, Go to Q21.
Do not ask Q20 in the following cases: a) Q02=7 AND (Q14=1 and/or Q19=0); b) Q02=9 AND (Q17=1 and/or Q19=0)

Q20. Were there filters on vents and/or vent fans to control dust emissions in buildings used to house pigs or poultry during the reference period?

(fill in one circle only)
- ◯ 0 No
- ◯ 1 Yes
- ◯ 2 Not applicable
- ◯ 99 Not known

Do not ask Q21 if Q13=1 and/or Q14=1 and/or Q15=1 and/or Q17=1 (that is, if livestock are held "open/no housing")

Q21. Were there temperature controls in the buildings used to house livestock during the reference period?

(fill in one circle only)

- ◯ 0 No
- ◯ 1 Yes
- ◯ 2 Not applicable
- ◯ 99 Not known

PART 4.4: EQUIPMENT AND TRANSPORTATION OF ANIMALS DURING THE REFERENCE PERIOD (DD/MM/YYYY) TO (DD/MM/YYYY).

Q22. Was transhumance practised by the holding during the reference period?

- ◯ 0 No → Go to Q25.
- ◯ 1 Yes

Q23. Identify the types of animals for which transhumance was practised during the reference period.

(fill in all that apply)

- ◯ 1 Equidae
- ◯ 2 Cattle
- ◯ 3 Buffaloes
- ◯ 4 Camelidae
- ◯ 5 Sheep
- ◯ 6 Goats
- ◯ 999 Other (specify ☐)

Q24. Was cross-border transhumance practised during the reference period?

- ◯ 0 No
- ◯ 1 Yes

Q25. Were live animals transported from the holding to a slaughterhouse during the reference period?

- ◯ 0 No → Go to Q28.
- ◯ 1 Yes

REPEAT Q26 AND Q27 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.

Q26. Identify the main transportation method used to transport [LIVESTOCK] to a slaughterhouse during the reference period.

(fill in one circle only)

- ◯ 1 By foot
- ◯ 2 By road with motor véhicules
- ◯ 3 By rail véhicules
- ◯ 999 Other (specify ☐)

Q27. Report the frequency of transportation of live [LIVESTOCK] to a slaughterhouse during the reference period.

(fill in one circle only)

- ◯ 1 Weekly
- ◯ 2 Monthly
- ◯ 3 Once a year
- ◯ 999 Other (specify ☐)

CONTINUE Q26 AND Q27 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO Q28.

Q28. Were live animals transported from the holding to a market to sell them during the reference period?

- ◯ 0 No → Go to Q31.
- ◯ 1 Yes

REPEAT Q29 AND Q30 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.

Q29. Identify the main transportation method used to transport [LIVESTOCK] to a market during the reference period.

(fill in one circle only)

- ◯ 1 By foot
- ◯ 2 By road with motor véhicules
- ◯ 3 By rail véhicules
- ◯ 999 Other (specify ☐)

Q30. Report the frequency of transportation of live [LIVESTOCK] to a market during the reference period.

(fill in one circle only)

- ◯ 1 Weekly
- ◯ 2 Monthly
- ◯ 3 Once a year
- ◯ 999 Other (specify ☐)

CONTINUE Q29 AND Q30 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO Q31.

Q31. Were live animals transported to pastures outside the holding during the reference period?

- ◯ 0 No → Go to Q34.
- ◯ 1 Yes

REPEAT Q32 AND Q33 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.

Q32. Identify the main transportation method used to transport [LIVESTOCK] to pastures outside the holding during the reference period.

(fill in one circle only)

- ◯ 1 By foot
- ◯ 2 By road with motor véhicules
- ◯ 3 By rail véhicules
- ◯ 999 Other (specify ☐)

Q33. Report the frequency of transportation of [LIVESTOCK] to pastures outside the holding during the reference period.

(fill in one circle only)
- ◯ 1 Weekly
- ◯ 2 Monthly
- ◯ 3 Once a year
- ◯ 999 Other (specify ☐)

CONTINUE Q32 AND Q33 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO Q34.

Q34. Were live animals transported to another holding which fed them during the reference period?

- ◯ 0 No → **Go to Q37.**
- ◯ 1 Yes

REPEAT Q35 AND Q36 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.

Q35. Identify the main transportation method used to transport [LIVESTOCK] to another holding which fed them during the reference period.

(fill in one circle only)
- ◯ 1 By foot
- ◯ 2 By road with motor véhicules
- ◯ 3 By rail véhicules
- ◯ 999 Other (specify ☐)

Q36. Report the frequency of transportation of [LIVESTOCK] to another holding which fed them during the reference period.

(fill in one circle only)
- ◯ 1 Weekly
- ◯ 2 Monthly
- ◯ 3 Once a year
- ◯ 999 Other (specify ☐)

CONTINUE Q35 AND Q36 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO Q37.

Q37 is to be asked where Q02 = 1 (equidae) and/or 2 (cattle) and/or 3 (buffaloes) and/or 4 (camelidae). Each of these is considered [DRAFT LIVESTOCK].
Q37 is to be asked separately for each of the cases outlined above.
If Q02 does not equal 1 and/or 2 and/or 3 and /or 4, Go to PART 4.5, Q38.

Q37. Were [DRAFT LIVESTOCK] used for transport or draft animal power on the holding during the reference period?

- ◯ 0 No → **Go to PART 4.5, Q38.**
- ◯ 1 Yes

		Number
Q37a	How many [DRAFT LIVESTOCK] were used for transporting people, goods, etc. during the reference period?	☐☐
Q37b	How many [DRAFT LIVESTOCK] were used for draft animal power (ploughing, farming, etc.) on the holding during the reference period? . . .	☐☐

CONTINUE Q37 UNTIL ALL [DRAFT LIVESTOCK] ARE COVERED, THEN PROCEED TO PART 4.5, Q38.

PART 4.5: FEED AND USE OF PASTURES DURING THE REFERENCE PERIOD (DD/MM/YYYY) TO (DD/MM/YYYY).

REPEAT Q38 TO Q40 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.

Q38. Report the practices used for feeding [LIVESTOCK] during reference period.
* Report shares, by percent of the [LIVESTOCK] herd.

		Percent of [LIVESTOCK] herd
Q38a	Only grazing, including scavenging	___ %
Q38b	Mainly grazing, including scavenging, with some feeding	___ %
Q38c	Mainly feeding, with some grazing, including scavenging	___ %
Q38d	Only feeding (zero grazing or scavenging)	___ %
Q38e	**Total (calculated)**	___ %

If "Only grazing, including scavenging" is the only practice (that is, Q38a = 100%), go to Q45. Otherwise, go to Q39.

Q39. Report the types of feed fed to [LIVESTOCK] during the reference period.
* Report shares, by percent of the feed used over the reference period.

If [LIVESTOCK] = pigs or poultry {i.e., Q02 = 7 (pigs) or 9 (poultry)}, do not include Q39a in the response options.

		Percent	
Q39a	Forages, including roughages	___ %	*RESPONSE BECOMES VARIABLE [FEED].*
Q39b	Crops and agro-industrial by-products, including concentrate	___ %	
Q39c	Swill and household wastes	___ %	
Q39d	**Total (calculated)**	___ %	

Q40. Were supplements and/or additives fed to [LIVESTOCK] during the reference period?
- ◯ 0 No
- ◯ 1 Yes

CONTINUE Q38 TO Q40 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO Q41.

ASK Q41 FOR [FEED] WHEN IT WAS REPORTED IN Q39d AS > 0% FOR AT LEAST ONE TYPE OF [LIVESTOCK].
REPEAT Q41 FOR ALL FEED TYPES IDENTIFIED IN Q39.

Q41. Report the sources of [FEED] used during the reference period.

If Q39b > 0% for at least one type of [LIVESTOCK]}, do not include Q41b in the response options.
If Q39c > 0% for at least one type of [LIVESTOCK]}, do not include Q41b or Q41c in the response options.

		Percent	
Q41a	Produced on the holding	___ %	*RESPONSE = [FEED SOURCE].*
Q41b	Common pasture	___ %	
Q41c	Purchased	___ %	
Q41d	Exchanged	___ %	
Q41e	Received for free	___ %	
Q41f	**Total (calculated)**	___ %	

CONTINUE Q41 UNTIL ALL [FEED]S ARE COVERED, THEN PROCEED TO Q42.
ASK Q42 FOR CASES WHERE Q39a > 0% AND Q41c > 0% (that is, WHERE FORAGES, INCLUDING ROUGHAGES WERE PURCHASED).

Q42. Report the quantity of fodder (forages, including roughages) that were purchased during the reference period.

		Quantity	Unit of measure (see codes)	Conversion factor to a standard unit	Quantity calculated in standard unit
Q42a	Hay				
Q42b	Wrapped grass				
Q42c	Grass or hay silage				
Q42d	Maize (grain)				
Q42e	Maize silage				
Q42f	Other (specify ____)				
Q42g	**Total (calculated)**				

ASK Q43 FOR CASES WHERE ANY [FEED] > 0% (FROM Q39) AND Q41c > 0% (i.e., WHERE FEED WAS PURCHASED).

Q43. Identify the months during which purchased feed was used to feed livestock.

(fill in all that apply)
- ◯ 1 January
- ◯ 2 February
- ◯ 3 March
- ◯ 4 April
- ◯ 5 May
- ◯ 6 June
- ◯ 7 July
- ◯ 8 August
- ◯ 9 September
- ◯ 10 October
- ◯ 11 November
- ◯ 12 December

DO NOT ASK Q44 AND Q45 IF "Only feeding (zero grazing or scavenging)" IS THE ONLY PRACTICE (that is, Q38d = 100%).

REPEAT Q44 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.
WHERE [LIVESTOCK] = 1, 2, 3, 4, 5 OR 6 (that is, EQUIDAE, CATTLE, BUFFALOES, CAMELIDAE, SHEEP OR GOATS) ASK Q44 SEPARATELY.
WHERE [LIVESTOCK] = 7, 8, 9, 10 OR 11 (PIGS, RABBITS, POULTRY, INSECTS, OTHER), ASK Q44 AS ONE QUESTION FOR "OTHER LIVESTOCK".

Q44. Report the grazing practices for [LIVESTOCK] used during the reference period.

	Area	Unit of measure (see codes)	Conversion factor to a standard unit	Area calculated in standard unit	Number of animals	Number of months
Q44a Grazing on the holding						
Q44b Grazing on a common pasture						

CONTINUE Q44 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO Q45.

Q45. Report the amount of manure (free fall) that was collected from pasture to be used as fuel during the reference period.

(fill in one circle only)

- ◯ 1 No manure was removed from pasture to be used as fuel
- ◯ 2 A small part of the manure on pasture was removed to be used as fuel
- ◯ 3 About half of the manure on pasture was removed to be used as fuel
- ◯ 4 Most or all of the manure on pasture was removed to be used as fuel

PART 4.6: WATERING OF ANIMALS DURING THE REFERENCE PERIOD (DD/MM/YYYY) TO (DD/MM/YYYY).

Q46. Was the main source of water for watering livestock the same for all seasons during the reference period?

◯ 0 No → **Go to Q48.**
◯ 1 Yes

REPEAT Q47 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.

Q47. Identify the main source of water used for watering [LIVESTOCK] during the entire reference period.

(fill in one circle only)
◯ 1 Borehole
◯ 2 Well
◯ 3 Dam or lake
◯ 4 River, spring or stream
◯ 5 Rainwater harvesting
◯ 999 Other (specify ☐)

CONTINUE Q47 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO Q48.

REPEAT Q48 AND Q49 FOR ALL LIVESTOCK TYPES IDENTIFIED IN Q02.

Q48. Identify the main source of water used for watering [LIVESTOCK] during the dry season.

(fill in one circle only)
◯ 1 Borehole
◯ 2 Well
◯ 3 Dam or lake
◯ 4 River, spring or stream
◯ 5 Rainwater harvesting
◯ 999 Other (specify ☐)

Q49. Identify the main source of water used for watering [LIVESTOCK] during the rainy season.

(fill in one circle only)
◯ 1 Borehole
◯ 2 Well
◯ 3 Dam or lake
◯ 4 River, spring or stream
◯ 5 Rainwater harvesting
◯ 999 Other (specify ☐)

CONTINUE Q48 AND Q49 UNTIL ALL [LIVESTOCK] ARE COVERED, THEN PROCEED TO Q50.

Q50. Were problems encountered in watering livestock during the reference period?

◯ 0 No → **Go to PART 4.7, Q57.**
◯ 1 Yes

Q51. Identify the months in which problems were encountered in watering livestock during the reference period.

(fill in all that apply)
◯ 1 January
◯ 2 February
◯ 3 March
◯ 4 April
◯ 5 May
◯ 6 June
◯ 7 July
◯ 8 August
◯ 9 September
◯ 10 October
◯ 11 November
◯ 12 December

Q52. Identify the main problem encountered in watering livestock during problematic periods.

(fill in one circle only)
◯ 1 Restricted access to water sources
◯ 2 Lack of water in usual water sources
◯ 3 Poor quality of usual water sources
◯ 999 Other (specify ☐)

Q53. Identify the solution that was implemented to provide water to livestock during problematic periods.

(fill in one circle only)
◯ 1 Use of another water source near the holding, for free (neighbours, etc.)
◯ 2 Use of another water source near the holding, with payment (cash or exchange of products or services)
◯ 3 Use of another water source far from the holding, for free (public help, etc.)
◯ 4 Use of another water source far from the holding, with payment (cash or exchange of products or services)
◯ 999 Other (specify ☐)

ASK Q54 WHEN Q53 = 3 OR 4. OTHERWISE, GO TO PART 4.7, Q57.

Q54. Was water for livestock transported by trucks?

◯ 0 No → **Go to PART 4.7, Q57.**
◯ 1 Yes

Q55. During which months was water for livestock transported by trucks?

(fill in all that apply) *RESPONSE = [MONTH]*

- ◯ 1 January
- ◯ 2 February
- ◯ 3 March
- ◯ 4 April
- ◯ 5 May
- ◯ 6 June
- ◯ 7 July
- ◯ 8 August
- ◯ 9 September
- ◯ 10 October
- ◯ 11 November
- ◯ 12 December

REPEAT Q56 FOR ALL MONTHS IDENTIFIED IN Q55.

Q56. Report the frequency of transporting water by trucks during [MONTH].

(fill in one circle only)

- ◯ 1 Daily
- ◯ 2 Weekly
- ◯ 3 Monthly

CONTINUE Q56 UNTIL ALL [MONTH] ARE COVERED, THEN PROCEED TO PART 4.7, Q57.

PART 4.7: MANURE MANAGEMENT DURING THE REFERENCE PERIOD (DD/MM/YYYY) TO (DD/MM/YYYY).

Q57. Identify the types of manure produced on the holding during the reference period.

(fill in all that apply) *RESPONSE = [MANURE].*

- ◯ 1 Solid dung
- ◯ 2 Liquid manure
- ◯ 3 Slurry

Q58. Was manure produced on this holding and sold or given to others during the reference period?

CAN BE ASKED BY TYPE OF MANURE - [MANURE]

- ◯ 0 No → **Go to Q61.**
- ◯ 1 Yes

Q59. Report the quantity of manure that was produced on this holding and sold or given to others during the reference period.

	Quantity	Unit of measure (see codes)	Conversion factor to a standard unit	Quantity calculated in standard unit

Q60. Report the payment terms for the manure that was sold or given to others during the reference period.

	Percent
Q60a Share of moved manure that was exchanged for goods and/or services	%
Q60b Share of moved manure that was sold	%
Q60c Share of moved manure that was given away for free	%
Q60d **Total (calculated)**	%

REPEAT Q61 AND Q62 FOR ALL MANURE TYPES IDENTIFIED IN Q57.

Q61. Report the number of months that [MANURE] was managed using each of the following manure management systems during the reference period.

If [MANURE] = "Solid manure" (that is, Q57 = 1), do not include Q61b in the response options.
If [MANURE] = "Liquid manure" (that is, Q57 = 2), do not include Q61b in the response options.
If [MANURE] = "Slurry" (that is, Q57 = 3), do not include Q61c, Q61d or Q61e in the response options.

	Months
Q61a Digester (biogas reactor)	
Q61b Slurry tank	
Q61c Anaerobic lagoon	
Q61d Aerobic lagoon	
Q61e Aerobic treatment	
Q61f Other (specify)	

Q62. What share of the manure storage facility for [MANURE] was covered (to keep off rain or reduce emissions of manure gases) during the reference period?

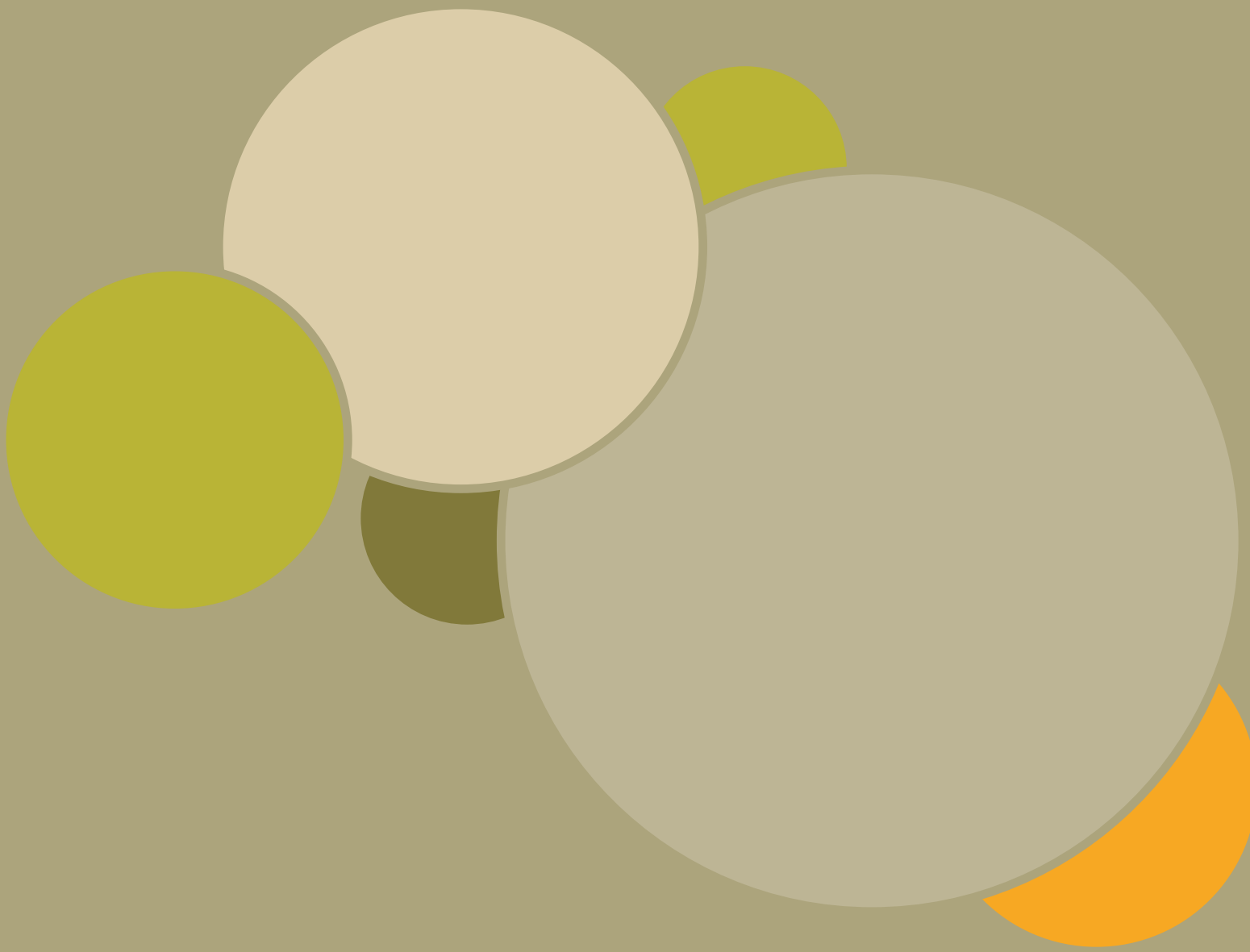
Percent ___ %

CONTINUE Q61 AND Q62 UNTIL ALL [MANURE] ARE COVERED, THEN PROCEED TO Q62.

Q63. Report the quantity of manure produced on the holding that was used for the following purposes during the reference period.

	Quantity	Unit of measure (see codes)	Conversion factor to a standard unit	Quantity calculated in standard unit
Q63a For fuel (including heating)				
Q63b For construction				
Q63c For feed				

Comments on SECTION 4:



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