LIVESTOCK PRODUCTION AND PRODUCTIVITY

Session 2: Items and indicators
Objectives of the presentation

• Present the main indicators that are needed to be compiled when doing livestock statistics

• Present the items to collect

• Discuss the data sources of each indicator
Introduction

1) Livestock stocks
2) Meat production
3) Milk production
4) Egg production
5) Animal health
6) Feed availability
7) Watering practices
Introduction

Developed countries: maintain large data sets and long-time series

VS

Developing countries: No regular production of large data sets

BUT FOR BOTH CATEGORIES

MINIMUM SET OF CORE DATA NEED TO BE PRODUCED FOR LIVESTOCK STATISTICS
Introduction

- In the Guidelines on livestock production and productivity, 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.

- The large majority of the items is generally collected through observation or surveys on agricultural holdings. Some from administrative records.

- The items are used to calculate or estimate indicators on livestock production or productivity.
To produce livestock data, the items to be collected and data collection methods need to be determined. These are dictated or influenced by:

- decisions and decision-makers that will be informed
- scope and goal of the study, survey or collection exercise
- indicators being targeted
- analysis and disaggregation required
- target commodities and livestock types, and associated inputs and production and marketing systems
- nature of respondents
- reliability of recall, and other options such as direct measurement and proxy measurement
- role of respondent
- resources available
- expected level of precision of estimates
1 Livestock stocks
1.1. Livestock stocks: Introduction

• Livestock stocks
  ➢ Number of animals
  ➢ Herd structure
  ➢ Herd dynamics

• These concepts are linked and require a good understanding
1.2. Livestock stocks: Number of animals

- Includes domestic animals by species (if significant):
  - Cattle
  - Sheep
  - Goats
  - Pigs
  - Poultry

- Kept on the territory of the country at a reference day

- Other animal species can be included according to the national priorities and realities
1.2. Livestock stocks: Number of animals

- The number of animals present on the farm at the given reference day include:
  - All animals being raised by the agricultural holding on the reference day of the survey, regardless of the ownership
  - Also animals raised by the holding but temporally not present on it for being grazed or in transit at the day of the enumeration

- Do not include:
  - Livestock belonging to another holding moved temporarily for sanitary or other reasons (sanitary cleaning, etc.)
1.2. Livestock stocks: Number of animals

- Variables required: total number of animals per species

- Geographical aggregation: Country, Region etc.

- Frequency of estimation:
  - Annually for all species
  - Semi-annually for sheeps, goats and pigs
  - Semi-annually or quarterly for poultry

- Observation unit: agricultural holding
1.3. Livestock stocks: Herd structure

• Number of animals broken down in groups by breed, age, sex, livestock system etc.

• These indicators should be produced for the same livestock species for which the *Number of animals* is estimated.

• As a minimum requirement, the number of reproductive female animals should be produced: cows, ewes, female goats, sows, laying hens
1.4. Livestock stocks: Herd structure

- **Variables required:** number of livestock by category
- **Geographical aggregation:** Country, Region etc.
- **Frequency of estimation:** annually
- **Observation unit:** agricultural holding
- **Reference period:** single reference day
1.4. Livestock stocks: 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 species for which the *Number of animals* is estimated.

• As a minimum, the following movements must be estimated:
  ➢ number of animals born
  ➢ number of animals slaughtered on the farm or elsewhere on behalf of the agricultural holdings
1.4. Livestock stocks: Herd dynamics

• Other entries and 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 sold, given or otherwise disposed animals
  - number of purchased, received as donation or otherwise acquired animals

• If the animal death is an important exit for a particular country, specie or region, it can also be estimated at farm level as:
  - number of dead animals, broken down by causes of death
1.4. Livestock stocks: Herd dynamics

- **Variables required:**
  - Number of births
  - Number of animals purchased
  - Numbers of other entries of animals
  - Number of animals slaughtered
  - Number of animals sold
  - Number of animals otherwise disposed
  - Number of other exits of animals

- **Geographical aggregation:** Country, Region etc.

- **Frequency of estimation:** annually

- **Observation unit:** agricultural holding
1.5. Livestock stocks: Indicators

• The fertility rate:
  - Number of births divided by the number of female reproductive animals (cows, ewes, female goats, etc.)

• Off-take rate:
  - 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

• Growth rate:
  - Difference between the stock at the end and the stock at the beginning of the reference period divided by the stock at the beginning

• Livestock production:
  - 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 and payments in kind are included if significant in the country
## 1.5. Livestock stocks: Indicators

### Example

<table>
<thead>
<tr>
<th>Herd dynamics</th>
<th>Code</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bovines stock at the beginning</td>
<td>a</td>
<td>285</td>
</tr>
<tr>
<td>of which cows</td>
<td>k</td>
<td>131</td>
</tr>
<tr>
<td>Births</td>
<td>b</td>
<td>89</td>
</tr>
<tr>
<td>Purchase</td>
<td>c</td>
<td>14</td>
</tr>
<tr>
<td>Gifts</td>
<td>d</td>
<td>13</td>
</tr>
<tr>
<td>Other entries</td>
<td>e</td>
<td>2</td>
</tr>
<tr>
<td>Deaths</td>
<td>f</td>
<td>4</td>
</tr>
<tr>
<td>Sales</td>
<td>g</td>
<td>14</td>
</tr>
<tr>
<td>Gifts</td>
<td>h</td>
<td>23</td>
</tr>
<tr>
<td>Other exits</td>
<td>i</td>
<td>14</td>
</tr>
<tr>
<td>Bovines stock at the end</td>
<td>j</td>
<td>348</td>
</tr>
<tr>
<td>of which cows</td>
<td>l</td>
<td>116</td>
</tr>
</tbody>
</table>

### Livestock balance: Stock at the end are equal to the 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

\[ \text{Average number of bovines} = \frac{(a + j)}{2} = 317 \]

\[ \text{Average number of cows} = \frac{(k + l)}{2} = 124 \]

### Fertility rate: The number of calves born divided by the average number of cows

\[ \text{Fertility rate} = \frac{b}{\frac{(k + l)}{2}} = 0.72 \]

### Off-take rate: The total number of animals slaughtered, sold or otherwise disposed of divided by the average number of the herd

\[ \text{Off-take rate} = \frac{(g + h + i)}{\frac{(a + j)}{2}} = 0.16 \]

### Growth rate: Difference between the stock at the end and the stock at the beginning divided by the stock at the beginning

\[ \text{Growth rate} = \frac{(j - a)}{a} \text{ or } \frac{j}{a} - 1 = 0.22 \]
1.6. Livestock stocks: Results field test

- Few alternatives to recall
- Substantial scope for farmer participation via record keeping
- Good applications of communal methods
- Distinct role for sampling
- Role of information on Breeds
- Seasonality to be taken into consideration
- Consistency with classifications: age/sex/breed
- Market outlets – notably the role of farmer-to-farmer trade
Meat production
2.1. Meat production: 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 species for which the Number of animals is estimated

• Annual growth can be a positive or negative value

• The estimation of the indicator Meat production on hoof (the total live weight of live animals) would be more relevant if the number and average weights are estimated per category of livestock
2.1. Meat production: Meat production on hoof

• **Variables required (at the beginning and the end of the reference period):**
  - Number of livestock per category
  - Average live weight per group of livestock

• **Geographical aggregation:** Country, Region etc.

• **Frequency of estimation:** annually

• **Measurement unit:** 1000 tons of live weight
2.2. Meat production: 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 given reference period

- **Include:**
  - Slaughtering on the farm
  - Slaughtering in slaughterhouses
  - Other slaughtering points such as butcher shops, restaurants, etc. including communal or religious institutions which perform irregular slaughtering for festivals or other community events

- **Important to avoid double counting**
2.2. Meat production: Meat production from slaughtered animals

• **Variables required:**
  - Number of animals slaughtered on the farm
  - Number of animals slaughtered on the slaughtered house
  - Number of animals slaughtered on other slaughtered points
  - Average carcass weight per category of livestock

• **Geographical aggregation:** Country, Region etc.

• **Frequency of estimation:** annually, semi-annually, quarterly or monthly

• **Measurement unit:** 1000 heads, 1000 tons of carcass weight
2.3. Meat production: Indicators

• **Total live weight of a herd:**
  - The sum of the live weight of all animals in the herd
  - The total number of animals multiplied by the average live weight per animal

• **Meat production on the hoof** (animal growth)
  - Derived variable from the live weight at the beginning and at the end of the reference period, usually 12 months
## 2.3. Meat production: Indicators

- **Example**

<table>
<thead>
<tr>
<th></th>
<th>At the beginning of reference period</th>
<th>At the end of reference period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total number</td>
<td>Average live weight (kg)</td>
</tr>
<tr>
<td>Sheep</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td></td>
<td>87</td>
<td>16.2</td>
</tr>
<tr>
<td>Goats</td>
<td>55</td>
<td>12.6</td>
</tr>
</tbody>
</table>

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
2.3. Meat production: Indicators

• Gross Indigenous Product:
  - Calculated per livestock species at national level for certain reference period, usually 12 months
  - Foreign trade data on import and export of live animals has to be obtained from the relevant customs institution

• Equal to:

Total slaughtering regardless of their origin and the slaughtering point (slaughterhouse, farm or other) + Export of live animals (regardless of their future utilisation) – Import of live animals (regardless of their future utilisation)
2.4. Meat production: 
Results field test

• Proxy measures could be used

• Need for Gold Standard measures + calibration

• Consistency with classifications: age/sex/breed

• Sampling

• Seasonal fluctuations

• Knowledge of sales patterns/herd dynamics provide income-relevant inference
3 Milk production
3.1. Milk production: Total milk production

- Two basic concepts are used:
  - *Gross production*, which includes whole fresh milk actually milked regardless of its’ 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 its’ future use; the quantities of milk sucked by the young animals being difficult to obtain, are excluded.

- Include milk production from:
  - Cows
  - Sheeps
  - Goats
  - Milked quantities used to feed livestock

- Exclude:
  - Milk sucked by young animals
3.1. Milk production: Total milk production

- Milk from other species of animals can be included according to national priorities.

- The data on milk production refers to the net milk production, i.e. total production of whole fresh milk.

- In case the indicator is estimated in litres, it has to be recalculated in tonnes using a converting coefficient.
3.1. Milk production: Total milk production

- **Variables required:**
  - Number of milking cows
  - Number of milking sheeps
  - Number of milking goats
  - Other milking animals
  - Average milk produced per cow, ewe, goats during the reference period

- **Geographical aggregation:** Country, Region etc.

- **Frequency of estimation:** annually, semi-annually, quarterly or monthly

- **Measurement unit:** 1000 tons
3.2. Milk production: Milk utilisation

• Total milk production broken down by type of utilisation:
  ➢ Fresh milk sold to dairies
  ➢ Direct sales of fresh milk
  ➢ Fresh milk used for home consumption (household holdings)
  ➢ Fresh milk used for animal feed
  ➢ Fresh milk processed on the farm (to produce cheese, butter, yogurt, cream, etc.)
3.2. Milk production: Milk utilisation

- **Variables required:** share of milk by utilisation channels
- **Geographical aggregation:** Country, Region etc.
- **Frequency of estimation:** annually for the indicator but the data collection could be monthly, semi-annual or quarterly
- **Measurement unit:** 1000 tons per utilisation
3.3. Milk production: Results field test

• Milk measurement rather than recall
• Useful for farmer record keeping
• Gold Standard + calibration to lactation curve
• Lactation curves may not be of expected shape for indigenous cattle in low input systems
• Necessity to exercise sampling strategy on choice of cows
• Breed disaggregation
• Revisions to data items which do use recall (calving interval, numbers of cows as base)
• Communal methods for seasonal distribution, across samples taken in various seasons
• Calf suckling
Egg production
4.1. Egg production: Total eggs produced

• **Covers:**
  - All eggs produced during the reference period regardless of its utilization (for laying or for consumption)
  - Total production of eggs, including also eggs for hatching

• As a minimum requirement, the annual egg production from laying hens has to be collected.

• It can be expressed either in total weight of eggs or in total number of eggs

• If other laying species are of interest in the country, data about their production should also be collected for national purposes
4.1. Egg production: Total eggs produced

- **Variables required:**
  - Number of laying hens
  - Average number of eggs produced per laying hens per reference period

- **Geographical aggregation:** Country, Region etc.

- **Frequency of estimation:** annually, semi-annually, quarterly or monthly

- **Measurement unit:** Tons or 1000 eggs
4.2. Egg production: Indicators and examples

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

\[
\text{Eggs}_{\text{hen}} = 300 \times \frac{52}{58} = 300 \times 0.9 = 270 \text{ eggs/hen/year}
\]

• 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, i.e. if there are 10 laying hens the

\[
\text{Eggs}_{\text{tot}} = 2700 \text{ eggs/year}
\]
4.2. Egg production: Indicators and examples

• **Example 2:** At the farm level the following information is obtained from the respondent: the number of laying hens is 10. On average, the farmer collects 6 eggs per day, with the exception of the winter months (November, December, January and February) when the average number of eggs produced per day drops to 4. The days in the 4 winter months are 120. The total number of eggs in one year (12 months) can be calculated as:

\[
\text{Eggs}_{\text{tot}} = \frac{(120 \times 4 + 245 \times 6)}{10} = \frac{(480 + 1470)}{10} = 1950 \text{ eggs/year}
\]

• The average number of eggs produced per laying hen on the farm in one year can be calculated as the total number of eggs is divided by the number of laying hens, i.e.

\[
\text{Eggs}_{\text{hen}} = 195 \text{ eggs/hen/year}
\]
4.2. Egg production: Indicators and examples

• **Example 3:** The project “Improving methods for estimating livestock production and productivity” tested an alternative method for estimating the egg production on the farm applicable to small holders. The following auxiliary variables are necessary to be collected either by the farmer or through a communal survey:
  - number of laying hens
  - average number of clutches per hen per year
  - average number of eggs per clutch

• If the number of laying hens is 10, the average number of clutches per year is 3 and the number of eggs per clutch is 10, the total number of eggs produced on the farm for 12 months can be calculated as:

\[ \text{Eggs}_{\text{tot}} = 10 \times 3 \times 10 = 300 \text{ eggs/year} \]
4.3. Egg production: Results field test

- Few alternatives to recall
- Focus on clutch duration, number and management
- Necessary to clarify hen numbers and breeds
- Necessity to conduct Gold Standard work on most aspects of clutches
- Poultry skill base needed
- Communal data on seasonal distribution
Animal health
5.1. Animal health: Use of veterinary services

- Number of holdings that have used veterinary services during the reference period

- Cover all professional veterinary services used to protect animal health for the livestock kept on the holding

- Type of services received includes curable treatment of diseases, surgical procedures, artificial insemination, breeding, vaccination, deworming, treatment against external parasites, general advice, etc.
5.1. Animal health: Use of veterinary services

- Includes services provided by government organizations, such as through veterinary field workers, as well as by the private sector.

- Two ways to estimate:
  - 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.
5.1. Animal health: Use of veterinary services

• **Variables required:**
  ➢ Number of visits by an extension officer/veterinarian, or Yes/No question

• **Geographical aggregation:** Country, Region etc.

• **Frequency of estimation:** annually

• **Measurement unit:** Number of visits or YES/NO
5.2. Animal health: Causes of death or disappearance

• Causes of death:
  - Diseases
  - Parasites
  - Accidents
  - Predators
  - Drought etc.

• As an option, the disappearance per cause such as strays or theft may be also estimated if important in the country
5.2. Animal health: Causes of death or disappearance

• **Variables required:**
  - Number of deaths (per causes)
  - Number of other exits of animals (per causes)

• **Geographical aggregation:** Country, Region etc.

• **Frequency of estimation:** annually for the indicator but the data collection could be Semi-Annually, Quarterly, Monthly

• **Measurement unit:** Number of heads
Feed availability
6.1. Feed availability: Harvested area, production of main fodder crops and purchased feed

• For the fodder crops from the list of main feed used on the farm according to national context and priorities

• Harvested area is the area from which production was collected during the crop year

• Production is the total quantity produced from fodder crop within the crop year

• Purchased feed is the quantity of feed purchased per type of feed during the reference period
6.1. Feed availability: Harvested area and production of main fodder crops

- **Variables required:**
  - Harvested area for each crop
  - Average yield for each crop
  - Quantity of feed purchased
  - Type of feed

- **Geographical aggregation:** Country, Region etc.

- **Frequency of estimation:** annually

- **Measurement unit:** ha, tons
6.2. Feed availability:
Total grazing area and stock rate of grazing area

• The grazing areas include:
  ➢ Agricultural areas
  ➢ Permanent pasture
  ➢ Other grazing areas

• If necessary, can be broken down as follow:
  ➢ Fenced grazing
  ➢ Communal grazing
  ➢ Rented grazing
  ➢ Roadsides and public area grazing
6.2. Feed availability: Total grazing area and stock rate of grazing area

• The stock 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
  ➢ Buffalos, equidae, etc. depending on national priorities
6.2. Feed availability:
Total grazing area and stock rate of grazing area

- There is no one uniform set of coefficients for conversion of livestock numbers in livestock units

- As an example the Tropical Livestock Unit (TLU) is commonly taken to be an animal of 250 kg live weight

<table>
<thead>
<tr>
<th>Species</th>
<th>TLU conversion factor</th>
<th>Species</th>
<th>TLU conversion factor</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>
6.2. Feed availability:
Total grazing area and stock rate of grazing area

• Variables required:
  - Total grazing area
  - Number of grazing animals

• Geographical aggregation: Country, Region etc.

• Frequency of estimation: annually

• Measurement unit: ha, LU/ha

• Observation unit: Agricultural holding, community
6.3. Feed availability: Number of days feeding with particular feed per livestock species

• Measures the number of days in 12 month period in which a livestock species is fed on particular feed.

• List of main type of feed per type and category of livestock has to be established at national and regional level.

• 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
6.3. Feed availability: Number of days feeding with particular feed per livestock species

• Countries have to establish the list of main feed 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.

• If the feeding practices within a livestock species are important for national purposes, this indicator can be calculated per livestock category (e.g. lambs and adult sheep).
6.3. Feed availability: Number of days feeding with particular feed per livestock species

- **Variables required for each feed of interest:**
  - Number of animals that have grazed/were fed on particular feed during the year
  - Number of days of used for grazing/for feed on particular feed

- **Geographical aggregation:** Country, Region etc.

- **Frequency of estimation:** annually

- **Measurement unit:** Number of days per type of feed per livestock species per year

- **Observation unit:** Agricultural holding, community
6.4. Feed availability: Data and issues

• The production of cereals and pulses to be used for fodder and 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 the custom data.

• Companies producing feed and by-products used for feed can be surveyed in order to estimate the availabilities of agro-industrial by-products/concentrate components.
6.4. Feed availability: Data and issues

• Productivity of livestock depends to a high 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 in the case of poultry, the animals are left on their own

• The feeding practices vary not only between livestock species but within the same species depending on the sex, age and purpose of the animal
Watering practices
7. Watering practices

• Watering practices by type of livestock may vary according to the period of the year (rain or dry season), the type of livestock system (grazing nomadic, semi-nomadic or sedentary; mixed or industrial), national context of water management etc

• Though it is not part of annual livestock production and productivity statistics the practices for watering of animals are an important element of the analysis of the feeding practices and environmental sustainability of livestock breeding
7. Watering practices

• It is difficult to estimate the quantity of water used for watering animals

➤ Statistics usually collect other indicators for analysis of practices and issues related to availability of water for the purposes of livestock breeding:
  o Main sources of water for watering animals during different seasons of the reference period
  o Months in which problems were encountered in watering during the reference period
  o Main problems encountered in watering livestock during the problematic periods and solutions implemented to provide water to the livestock
7. Watering practices

- Since the watering practices and issues are stable, the frequency of data related to watering of animals is considered structural data and is usually collected every 3 to 5 years.

- The reference period is a reference year corresponding to 12 months before a given reference day or to a 12-month period fixed by the national statistical office.

- Main sources of data are sample-based agricultural surveys and censuses. Administrative data can be also used.
Conclusion

• This presentation discussed the different variables and indicators that countries need to be compiled in the context of livestock production and productivity.

• It raised different issues that need to be addressed when compiling livestock statistics.

• Countries need to customize the indicators depending on the priorities, realities and agenda.
Thank You