



Food and Agriculture Organization
of the United Nations

GLOBAL STRATEGY TO IMPROVE AGRICULTURAL AND RURAL STATISTICS

TRAINING IN AGRICULTURAL STATISTICS

Module 4: Analytical frameworks and derived statistics

Module learning objectives

To review the following analytical frameworks and derived statistics:

- Economic accounts for agriculture and environmental-economic accounts
- Costs of production statistics
- Post-harvest losses
- Agricultural prices and price indexes
- Food security and food balance sheets

Plan of module 4

4.1- Economic accounts for agriculture and environmental-economic accounts

4.2-Costs of production

4.3-Post-harvest losses

4.4-Agricultural prices and price indexes

4.5-Food security and food balance sheets



4.1

Economic accounts for agriculture and environmental- economic accounts

4.1-1- Economic accounts for agriculture (1/3)

- Definition:
 - Economic accounts for agriculture offer a systematic comparable view of the economic activity of the agricultural sector
- They help to **monitor, analyse and evaluate** the agricultural economy as a whole and in relation to other sectors (suppliers of agricultural inputs or users of agricultural products in the natural or processed state)
- They use the recording and accounting rules of national accounts

4.1-1- Economic accounts for agriculture (2/3)

- They offer the necessary flexibility for adaptation to different national agricultural contexts
- They measure total agricultural production consisting of the sum:
 - of the production of agricultural products
 - of goods and services produced as part of secondary, non-agricultural activities

4.1-1- Economic accounts for agriculture (3/3)

- Drawing up economic accounts for agriculture (EAAs) involves:
 - determining the concept of production and economic units in agriculture
 - describing
 - the production process of investments
 - recording and evaluation methods
 - the statistical aspect of drawing up economic accounts (statistical sources, etc.)

4.1-1- Economic accounts for agriculture, Statistical sources (1/3)

The 5 statistical sources

1) Production

- is evaluated for almost all products using **statistics of quantities and prices**
 - ✓ Exception: production of agricultural services (value data).

2) Intermediate consumption:

- This is the consumption of:
 - fertilizer and dressing
 - crop protection products
 - oil products
 - veterinary expenses
 - equipment maintenance
 - building maintenance
 - other goods and services (except insurance services)

N.B.: purchases of seed by agricultural units are evaluated by quantity and value, as is feed consumption.

4.1-1- Economic accounts for agriculture, Statistical sources (2/3)

3) Subsidies:

- product subsidies
- operating subsidies

N.B.: Source of subsidies: administrative sources

4) Other items in the operating and income accounts:

- wage level
- property tax amounts
- interest paid by agricultural sector units
- net rental costs

4.1-1- Economic accounts for agriculture, Statistical sources (3/3)

5) Gross fixed capital formation in non-agricultural products:

- evaluation in:
 - o agricultural sector buildings and equipment
 - o property transfer costs

4.1-2- Environmental-economic accounts (1/3)

- Environmental-economic accounts:
 - analyse the link between the environment and the economy
 - organize environment data in a manner consistent with the accounting principles of the national accounts
 - meet the need to follow the link between economic activity and the environment closely

4.1-2- Environmental-economic accounts (2/3)

- Environmental-economic accounts contain detailed statistics describing:
 - 1) the size of natural resource stocks and their contribution to national wealth
 - 2) the extraction of these resources and their distribution between the following stakeholders:
 - enterprises
 - households
 - governments
 - rest of the world

4.1-3- Environmental-economic accounts (3/3)

3) the management and production of waste (liquid, solid and gases) by:

- industries
- households
- government services

4) expenditure on environmental protection by:

- enterprises
- households
- government services



4.2

Costs of production

4.2-1- Costs of production, Use

- Costs of production statistics are used as follows:
 - **At government level**, costs of production are used:
 - as a basis for economic analysis
 - as a basis for effective policies
 - for the effective allocation of resources
 - for better farmer targeting programmes
 - **At economic operator level**, as follows:
 - for more effective markets
 - for better decision-making by farmers (use of inputs, specialization in commodities, etc.)
 - for better decision-making by input producers

4.2-1- Costs of production, importance (1/2)

- To increase the relevance for various stakeholders:
 - based on different dimensions of the costs of production and profitability of the holdings described here

| Total cost = Variable costs + Fixed costs | | |
|---|------------------------|--|
| | Monetary costs | Capital cost |
| | Seed, fertilizers | Depreciation and opportunity cost of capital on machinery, buildings and equipment |
| | Paid work | |
| | Machinery | |
| | Non-monetary costs | Cost of the holding |
| | | Non-allocated fixed costs |
| | | Taxes, permits for the holding |
| | Family labour | Cost of land |
| Livestock and machinery | Land taxes and leasing | |

4.2-1- Costs of production, importance (2/2)

- To define and compile indicators to measure the profitability of the holding
- To construct input-output frameworks based on:
 - technical coefficients from estimating the cost of each of the main agricultural activities

4.2-2 Costs of production, units used

- the unit of measurement or unit of standardization must:
 - depend first on the type of agricultural activity
 - have an economic sense
 - be compatible with the unit used to value production
 - be easy to understand and use by:
 - farmers
 - analysts
 - other stakeholders affected by the agricultural economy
 - Examples of units of measurement:
 - production values
 - quantities produced
 - land areas

4.2-3- Costs of production, indicators (1/2)

- Costs of production are measured using the following indicators:
 - **Total costs per ha**= [monetary costs + non-monetary costs + cost of land + investment costs (depreciation and opportunity cost of capital) + general agricultural expenditure] / Total land area in ha
 - **Net yield per tonne of production**= [Value of production – Total costs] / Total production (in tonnes)
 - **Price per production unit**= Total costs / total production
 - **Use of energy per ha**= [fuel & lubricants used + electricity use] / Land area

4.2-3 Costs of production, indicators (2/2)

- **Use of fertilizer per hectare** = [fertilizer use] / land area
- **Use of pesticides per hectare** = [pesticide use] / land area
- **Environmental pressure** = Index [use x emission factor] / Land area
- **Productivity** = [Production value] / use of inputs
- **Total productivity of growth factors** = [Changes in production value] – Changes in input value

Exercise

- **Exercise 25: Cost of production**

4.3

Post-harvest losses

4.3- Post-harvest losses: definition

- Definition:
 - All losses of agricultural products:
 - essentially food
 - along the agricultural value chain from production in the fields to final product distribution
 - losses are clearly a waste of:
 - food
 - human effort
 - agricultural inputs
 - livelihood
 - investment
 - scarce resources such as water

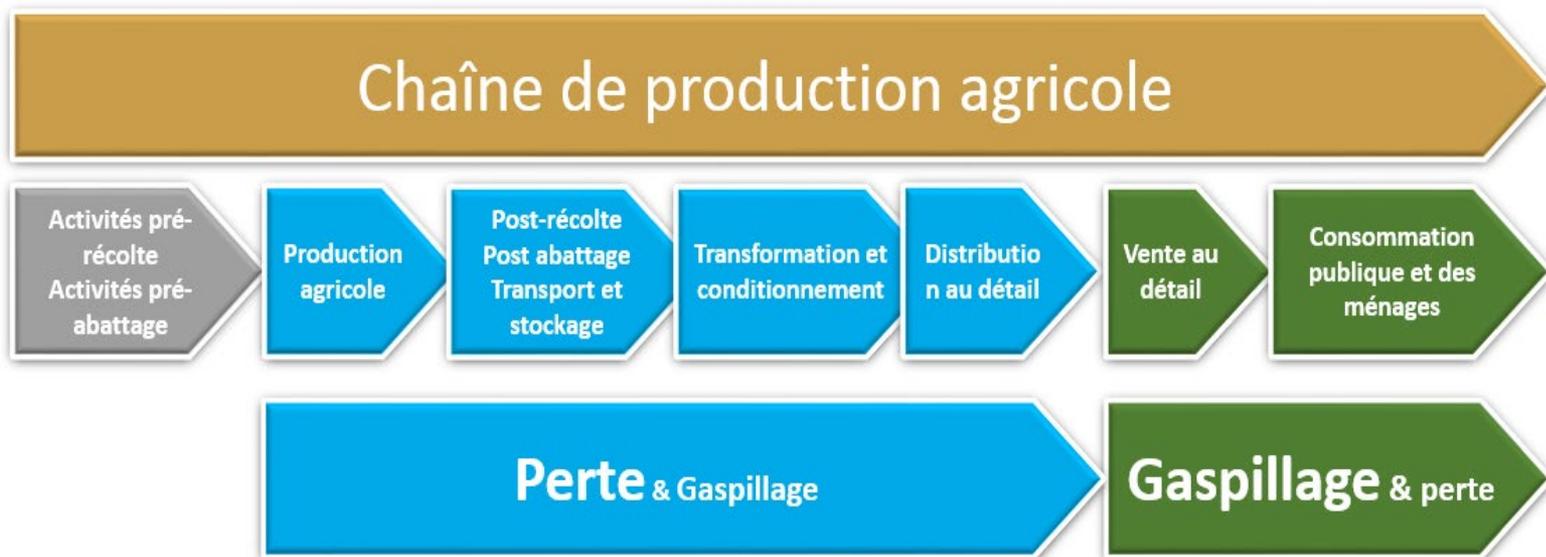
4.3- Post-harvest losses: components of the production chain for estimating post-harvest losses

- Stages when losses are observed:
 - all levels of the production chain, namely:



4.3- Post-harvest losses: Difference between post-harvest losses and waste

- **Post-harvest losses:** cover everything that is unintentional on the part of production chain stakeholders
- **Waste:** is related to losses caused intentionally by stakeholders



4.3- Post-harvest losses: Causes

- Post-harvest losses are caused by various factors ranging from:
 - production practices...
 - ...to transport at the retail level

4.3.1-Types of post-harvest losses (1/3)

- Types of post-harvest losses: **6 specific cases** can be highlighted:
 - **Agricultural production losses** are due:
 - to mechanical damage
 - and/or spillage during harvest operations (for example threshing or fruit picking)
 - post-harvest sorting, etc.
 - **Losses in post-harvest operations and storage** are due:
 - to spillage and degradation during:
 - ✓ handling
 - ✓ storage
 - ✓ and transport between farm and distribution centres

4.3.1 Types of post-harvest losses (2/3)

- **Losses in processing**
 - are **due to spillage and degradation** during industrial or domestic processing
 - **may occur** when harvested crops are **rejected**:
 - ✓ if unsuitable for processing
 - ✓ or during washing, peeling, slicing or boiling
 - ✓ or following process interruptions or
 - ✓ accidental spillage

4.3.1 Types of post-harvest losses (3/3)

- **Losses and waste in distribution** occur during marketing
 - Example:
 - ✓ wholesale markets,
 - ✓ supermarkets,
 - ✓ retailers
 - ✓ and fresh products markets
- **Losses and waste in consumption** occur during household consumption

4.3-2- Methods of estimating post-harvest losses

- Three (3) methods of estimating post-harvest losses:
 - 1) **Probability surveys**
 - 2) **Case studies**
 - 3) **Multivariate linear models or equations**

4.3-2- Methods of estimating post-harvest losses, probability surveys (1/2)

1) Probability surveys: two approaches

i. Objective approach: 2 methods

- ***Physical measurements***: reproducing the farmer's agricultural practices for all the operations in the production chain and measuring losses at each stage
- ***Visual scales***: showing farmers images of various stages of deterioration of an agricultural product so that they can choose the image that best matches their situation

4.3-2- Methods of estimating post-harvest losses, probability surveys (2/2)

ii. Subjective approach:

- Declaration by the holder of the losses recorded at different stages in the production chain
- Subjective because the estimate is based on the holder's perception rather than on measured losses

4.3-2- Methods of estimating post-harvest losses, case studies

2) Case studies or field tests

- Storage simulation tests performed at research stations with a high degree of control of the experimental conditions

4.3-2- Methods of estimating post-harvest losses, Multivariate linear models or equations

3) Multivariate linear models or equations

- Variables considered:
 - temperature, humidity, insect attacks, etc.
- Type of variables:
 - quantitative and/or qualitative
- The interactions between the different variables are sometimes taken into account

4.3-3- Extent and estimation of losses (1/2)

- Accurate estimates of the extent of loss and waste **still inadequate**, particularly in developing countries
- FAO has estimated global **levels of food loss and waste** at:
 - approximately 30% annually for cereals
 - 40-50% for tubers and fruit and vegetables
 - 20% for oil crops, meat and dairy products
 - 30% for fish

4.3-3- Extent and estimation of losses (2/2)

- Approximately one-third (**i.e. 1.3 billion tonnes annually on average**) of edible food intended for human consumption is lost or wasted
- Limitations of estimates
 - There are **far fewer estimates** for:
 - perishable foods (such as fruit and vegetables, roots and tubers) yet these are subject to huge losses
 - livestock products (fish, milk or meat)

4.3-4- Factors influencing losses, internal factors (1/2)

- Internal factors influencing losses concern:
 - the food supply chain
 - harvest
 - transport
 - storage
 - processing
 - marketing

4.3-4- Factors influencing losses, internal factors (1/3)

4 key internal factors influencing losses:

1) Harvest

- the best time for harvesting is determined by how ripe crops are and by meteorological conditions
- The main causes of losses during harvesting are the following:
 - o Lack of an established ripeness indicator for some products
 - o Poor meteorological conditions affecting harvesting operations
 - o Use of inappropriate harvesting methods

4.3-4- Factors influencing losses, internal factors (2/3)

2) Transport

- the main transport challenges in the supply chain are related to:
 - o inadequate infrastructure (roads, bridges, etc.)
 - o lack of appropriate transport systems
 - o lack of refrigerated transport

3) Storage

- Inadequate infrastructure installed
- Poor compliance with hygiene requirements to ensure effective storage over time
- Inappropriate checks on cleanliness, temperature and humidity for closed facilities
 - o granaries, warehouses, airtight silos, hoppers
- Poor management of damage caused by pests (insects or rodents) and mould, which can lead to the deterioration of facilities and also cause losses in nutrient quality and value

4.3-4- Factors influencing losses, internal factors (3/3)

4) Primary processing

- The causes of post-harvest losses in this phase include:
 - o The limited availability of varieties suited to processing
 - o Lack of appropriate processing technologies
 - o Unsuitability of new marketing techniques
 - o Lack of basic infrastructure
 - o Unsuitability of equipment and infrastructure
 - o Poor promotion of processed products

4.3-4- Factors influencing losses, external factors (1/4)

- External factors have an influence outside the food supply chain
- They can be divided into several types:
 - 1) environmental factors**
 - 2) socioeconomic factors**
 - 3) biological, microbiological and chemical factors (less important)**
 - 4) other factors**

4.3-4- Factors influencing losses, external factors (2/4)

- ***Environmental factors*** can influence harvest quantity and **quality**:
 - wind
 - humidity
 - precipitation
 - temperature
- ***Socioeconomic factors*** are related to urbanization
 - Urbanization, itself a source of high demand for food products in urban centres
 - Consequence:
 - food supply chains must be more efficient and better supported

4.3-4- Factors influencing losses, external factors (3/4)

- **Biological factors are strongly dependent on environmental factors and are related to:**
 - the transpiration rate of products
 - the action and production rate of ethylene
 - the rate of change of product composition (associated with colour, texture, flavour and nutrient value)
 - mechanical damage
 - physiological imbalance, etc.
- **Micro-organisms** are a source of food losses in terms of quality and nutrient value through:
 - toxic substances produced by moulds (called mycotoxins)

4.3-4- Factors influencing losses, external factors: other (2/2)

- ***Chemical factors*** are related to the natural presence of chemicals in stored foods: they cause
 - loss of colour, flavour, texture and nutritional value
 - browning and discoloration of dried fruit and other products
- ***The other factors*** are related to the importation of products which can:
 - introduce new pest species
 - constitute a major socioeconomic problem (Bocal 2001 in ACF, 2014)

4.3-5- Consequences of post-harvest losses, socioeconomic consequences

- Increased poverty and hunger
- Food chain dysfunction and poor performance
- Economic loss for operators working in food chains
- Increase in food prices
- Reduction in the potential benefits of increased performance, particularly for smallholders

4.3-5- Consequences of post-harvest losses, consequences for food and nutrition security

- **For food security:** post-harvest losses increase food insecurity through:
 - reduction in the quantity of food available for the producer
 - low price levels,
 - unavailability of food
 - poor food quality
 - malnutrition and poverty
- **For nutrition security**
 - Reduction in nutrients
 - Adverse effects on the health, wellbeing and productivity of consumers

4.3-5- Consequences of post-harvest losses, consequences for the environment and climate

- The effective non-use of energy, biodiversity, greenhouse gases, water, land and all other resources involved in the production of food causes:
 - Environmental degradation
 - Climate change

Exercise

- **Exercise 26: Post-harvest losses**

4.4

Agricultural prices and price indexes

4.4-1 Agricultural prices and price indexes: the various price types

- There is a succession of prices along the chain according to:
 - level of processing (added value)
 - costs of transport, storage, etc.
- The following diagram illustrates the components of a chain:

4.4-1 Agricultural prices and price indexes: the various price types

4.4-2 Agricultural prices and price indexes: price indexes

- **Definition:** An index is:
 - a statistical tool
 - generally used to describe the change in an economic variable in time or space
- 2 types of index:
 - 1) **Composite**
 - 2) **Elementary**

4.4-2 Agricultural prices and price indexes: elementary index (1/4)

- The elementary index
 - measures relative changes in a variable between two periods
 - allows the change in this variable to be compared in time (or in space)

4.4-2 Agricultural prices and price indexes: elementary index (2/4)

- Consider the change over time of a variable G , and let $G_0, G_1, G_2, \dots, G_t, \dots$ etc. be values of G on successive dates: $0, 1, 2, \dots, t, \dots$ etc.
- The following ratio is called the *elementary index of variable G on date t in relation to date 0* :

$$I_{t/0}(G) = \frac{G_t}{G_0} * 100$$

- Date 0 is called *base year*, or *reference year*. This is the comparison date. Date t , the date which is compared with it, is called the *current year*.

4.4-2 Agricultural prices and price indexes: elementary index (3/4)

- **Exemple:** l'indice élémentaire des prix du riz entre 2017 (année courante) et 2016 (année de base). Le prix moyen d'un kilogramme de riz dans votre pays est passé de 2,95 USD en 2016 à 3,39 USD en moyenne en 2017
- Quelle est la variation du prix du riz sur cette période ?
- Cela correspond à : $i_{2017/2016} = \frac{3,39}{2,95} = 1,15$
- Par ailleurs, l'indice élémentaire est le plus souvent exprimé en pourcentage. Dans ce cas, il est noté $I_{2017/2016} = i_{2017/2016} * 100 = \frac{3,39}{2,95} * 100 = 115\%$.
- Ce résultat traduit à une augmentation du prix du riz de 15% entre 2016 et 2017

4.4-2 Agricultural prices and price indexes: properties of an elementary index (4/4)

- **Circularity:** $I_{t/0}(G) = I_{t/t'}(G) * I_{t'/0}(G)$

This is a basic property which allows not only dates 0 and t to be compared, but also 0 and t' (an intermediate date)

- **Reversibility:** $I_{0/t}(G) = \frac{10000}{I_{t/0}}$

This property is useful particularly if a criterion other than time is being referred to

- **Chained calculations:**

$$I_{t/0}(G) = I_{(t,t-1)}(G) * I_{(t-1,t-2)}(G) * \dots * I_{1/0}(G)$$

The index on date t compared with date 0 is then obtained by finding the product of the intermediate indexes of a date compared with the previous date

4.4-2 Agricultural prices and price indexes: rate of change

- On appelle taux de variation de la grandeur X sur la période t_1 - t_2 la valeur

$$r_{\frac{t_2}{t_1}}(X) = \left(\frac{X_{t_2}}{X_{t_1}} - 1 \right) * 100 = I_{\frac{t_2}{t_1}}(X) - 1$$

- **Taux moyen de variation sur p-périodes :**

$$\bar{r} = \sqrt[p]{\prod_{i=1}^p \left(r_{\frac{t_i}{t_{i-1}}}(X) + 1 \right)} - 1$$

4.4-2 Agricultural prices and price indexes: composite index

- The composite index:
 - measures the change in the value of a complex variable (aggregation of a series of elementary variables)
 - makes it possible to capture the combined change in aggregates of the same type (the price of different agricultural products, for example) in a single indicator

4.4-2 Agricultural prices and price indexes: composite index

- **Why a composite index?**

Economics is interested in changes:

- in prices
- or quantities
- or in the value (product of price and quantity) of a variable between two dates or two spaces

- The elementary index of value:
$$I_{t,0}(PQ) = \frac{\sum_i P_t^i Q_t^i}{\sum_i P_0^i Q_0^i} * 100$$

- No distinction can be made between the contribution of price or of quantity in the aggregate change observed

4.4-2 Agricultural prices and price indexes: Laspeyres, Paasche and Fisher indexes

- Following the limitations of the elementary index, 3 composite indexes have been proposed:
 - 1) **Laspeyres index**
 - 2) **Paasche index**
 - 3) **Fisher index**

4.4-2 Agricultural prices and price indexes: Laspeyres, Paasche and Fisher indexes (1/2)

- Soit à la date 0, ω_0^i l'importance relative du constituant i dans la grandeur complexe G
- ω_t^i quantité analogue à la date t
- Les indices de Laspeyres et Paasche sont des moyennes des indices élémentaires, pondérées par les coefficients ω_t^i
- Considérons un panier de K biens. Le poids relatif à la période « 0 » du bien « i » se met sous la forme :

$$\omega_0^i = \frac{P_0^i * Q_0^i}{\sum_{j=1}^K P_0^j * Q_0^j} \text{ est aussi appelé coefficient budgétaire}$$

4.4-2 Agricultural prices and price indexes: Laspeyres, Paasche and Fisher indexes (2/2)

- Considérons un panier de K biens. Le poids relatif à la période « 0 » du bien « i » se met sous la forme:

$$\omega_0^i = \frac{P_0^i * Q_0^i}{\sum_{j=1}^K P_0^j * Q_0^j} \text{ est aussi appelé coefficient budgétaire.}$$

4.4-2 Agricultural prices and price indexes: Laspeyres composite index

- Ainsi, l'indice de Laspeyres de G , noté $L_{\frac{t}{0}}(G)$, est:
 - La moyenne arithmétique des indices élémentaires, pondérée par les coefficients de la date de référence ω_0^i :

$$L_{\frac{t}{0}}(G) = \sum_{j=1}^K \omega_0^i * \frac{G_t^i}{G_0^i} * 100$$

- L'indice de *Laspeyres* est le plus utilisé

4.4-2 Agricultural prices and price indexes: Paasche composite index

- L'indice de Paasche de G , noté $P_{\frac{t}{0}}(G)$, est la:
 - La moyenne harmonique des indices élémentaires, pondérée par les coefficients de l'année courante

$$P_{\frac{t}{0}}(G) = \sum_{j=1}^K \frac{\omega_t^i}{I_{\frac{t}{0}}(G)} * 100 = \sum_{j=1}^K \omega_0^i * \frac{G_0^i}{G_t^i} * 100$$

4.4-2 Agricultural prices and price indexes: Fisher composite index

- The Fisher index of G , written, $F_{t,0}(G)$ is the:
 - Simple geometric average of the Laspeyres and Paasche indexes:

$$F_{t,0}(G) = \sqrt{L_{t,0}(G) * P_{t,0}(G)}$$

4.4-2 Agricultural prices and price indexes: properties of composite indexes

- *Circularity*: None of these three indexes possesses the property of circularity
- *Reversibility*: only the Fisher index is reversible
- *Aggregation*: the Fisher index does not possess this property

- Laspeyres index:
$$L_{t,0}(G) = \sum_i \omega_0^i L_{t,0}(G^i)$$

- Paasche index:
$$\frac{1}{P_{t,0}(G)} = \sum_i \frac{\omega_t^i}{P_{t,0}(G^i)}$$

4.4-2 Agricultural prices and price indexes: quantity indexes

- On appelle indice quantité de *Laspeyres*, de *Paasche* et de *Fischer* ; les quantités:

$$L_{\frac{t}{\bar{0}}}(Q) = \frac{\sum_{j=1}^K P_0^j * Q_t^j}{\sum_{j=1}^K P_0^j * Q_0^j} * 100$$

$$P_{\frac{t}{\bar{0}}}(Q) = \frac{\sum_{j=1}^K P_t^j * Q_t^j}{\sum_{j=1}^K P_t^j * Q_0^j} * 100$$

$$F_{\frac{t}{\bar{0}}}(Q) = \sqrt{L_{\frac{t}{\bar{0}}}(Q) * P_{\frac{t}{\bar{0}}}(Q)}$$

- Ces indices mesurent l'évolution de la quantité à prix fixé

4.4-2 Agricultural prices and price indexes: value indexes

- On appelle indice de valeurs, la quantité :

$$I_{\bar{0}}^t(V) = \frac{\sum_{j=1}^K P_t^j * Q_t^j}{\sum_{j=1}^K P_{\bar{0}}^j * Q_{\bar{0}}^j}$$

- Cet indice mesure le double effet prix-quantité :

$$I_{\bar{0}}^t(V) = L_{\bar{0}}^t(Q) * P_{\bar{0}}^t(P)$$

$$I_{\bar{0}}^t(V) = L_{\bar{0}}^t(P) * P_{\bar{0}}^t(Q)$$

4.4-2 Agricultural prices and price indexes: notes

- L'indice de *Laspeyres* surévalue une hausse
- L'indice de *Paasche* à tendance à sous-évaluer une hausse
- L'indice des valeurs peut encore s'écrire :

$$I_{\bar{0}}(V) = F_{\bar{0}}(Q) * F_{\bar{0}}(P)$$

- L'indice de *Fisher* est compris entre l'indice de *Paasche* et l'indice de *Laspeyres*. On a : $P < F < L$.

4.4-2 Agricultural prices and price indexes:

constituents of a composite index, choice of criteria (1/2)

- **The choice and number of constituents of a composite index** is based on:
 - The representativeness of the constituents among the elements that can be part of the complex variable
 - The result of a balance between the technical and financial capabilities of observation and the marginal gain in accuracy obtained
 - The goal set when constructing a specific index
 - The weighting of the various components of the index

4.4-2 Agricultural prices and price indexes: constituents of a composite index, choice of criteria (2/2)

- **The choice of base:**

- **Generally:**

- the base is a geographically defined territorial unit
 - sometimes large conurbations are removed to avoid bias in calculating the index

- **For temporal indexes:**

- avoid dates in unusual boom or recession periods
 - choose a fairly broad period (annual rather than infra-annual, for example) to avoid the influence of seasonal and random variations
 - change the base fairly regularly. The date it is changed is called the link date

4.4-2 Agricultural prices and price indexes: problems using composite indexes (1/2)

- **Useful life of a composite index:**

- limited
- depends on the rate of change in components of the economy (consumption, production, distribution, etc.) and the behaviour of economic agents
- Solution: the splicing coefficient

$$CR = \frac{I_{b,0}}{100} = \frac{\text{Valeur de l'ancien indice}}{\text{valeur du nouvel indice}}$$

- let $I'_{t/b}$ be the new index value on a given date t. The base of this index is b, the link date. The spliced value of the new index on date t can be expressed, at base 0, as follows:

$$I_{t,0}^*(G) = I'_{t,b} * CR = I'_{t,b} * I_{b,0} * \frac{1}{100}$$

4.4-2 Agricultural prices and price indexes: problems using composite indexes (2/2)

- **Adjustments to quality changes**

- The appearance of new elementary constituents (new goods and therefore new consumer habits)
- The disappearance of old constituents
- A change in the quality of the proposed elements
- Solution:
 - implicit/imputed (or indirect) adjustment methods: imputation (corrected dissimilar), overlap pricing and direct comparison (replacement with equivalence)
 - explicit (or direct) adjustment methods: expert judgement, quantity adjustment, differences in costs of production or option method and the hedonic method

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, CPI (1/4)

- **The consumer price index (CPI)**
 - is a tool for measuring inflation
 - covers all marketable goods and services consumed on the territory by resident and non-resident households (such as tourists)
 - measures changes in the average prices of goods and services consumed by households, weighted according to their share in average household consumption (budgetary coefficient)
 - measures the effects of price changes on the acquisition cost of products consumed by households

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, CPI (2/4)

- **Use:** it estimates the average change, between two data periods, in the prices of products consumed by households
- **N.B.:** national price indexes have been harmonized to allow comparisons between member states:
 - the European Union Harmonized Index of Consumer Prices (HICP)
 - the WAEMU Harmonized Index of Consumer Prices (HICP)

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, CPI (3/4)

- **Constructing the CPI: 3 stages**

- 1) A basket of final representative goods and services is constructed
- 2) They are weighted according to their share in consumption
 - The weighting assigned to goods and services changes in parallel, but sometimes up to a year later (the weighting used for inflation in year N is based on consumption in year $N-1$).
- 3) Prices are collected by **continuous sampling and surveys**
 - The collection method used is a sample design generally stratified according to three types of criteria:
 - i. geographic
 - ii. product type
 - iii. point of sale type
 - Records are monthly

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, CPI (4/4)

- **Limits**

- Difficulties related to the appearance of a new product or service or a novel feature in an old product
- Difficulties related a change in the structure of the basket of goods:
 - If the price of an item increases one year more quickly than the prices of other items and if its share in consumption decreases, it is difficult to link it to the previous year
- The CPI is based on the average consumer basket
- The CPI can show a price increase if a person with a marginal profile perceives a fall in prices
- Difficulty of accounting for changes in product quality, consumer taste changes and exchange rate fluctuation

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, APPI (1/4)

- **The producer price index or Agriculture producer price index (APPI) measures:**
 - the average annual change in selling prices received by agricultural holders (farmgate prices)
 - changes in income from products sold by farmers, i.e. income received excluding subsidies (farmgate price)

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, APPI (2/4)

- Three **(3) categories** of producer price indexes are produced and available in FAOSTAT:
 - 1) the elementary producer price index for a single commodity
 - 2) the composite index for a commodity group (cereals, fruit and vegetables, etc.);

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, APPI (3/4)

3) the agriculture producer price index (all agricultural commodities and livestock products produced in a given country)

Example:

- producer price index for wheat
 - producer price index for rice
 - producer price index for maize
- These three indexes are drawn up using data on prices expressed in standardized local currency (SLC)

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, APPI (4/4)

- **Special features of the indexes**

- **Countries covered:** All countries for which price and production data are published on FAOSTAT
- **Reference year:** 2004-2006
- **Weighting coefficient** used for aggregated indexes (the Agriculture producer price index and the Commodity group indexes) is **the average production value for the period 2004-2006**
- The APPI is an aggregate index using the fixed-base Laspeyres index, with reference 2010
- Weightings are taken from the accounts for agriculture
- A specific APPI nomenclature is used

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, Agricultural production index

- **The agricultural production index**
 - shows the relative global agricultural production volume for each year in comparison with the reference period
 - is a **composite Laspeyres index** of quantities of the various agricultural commodities after the deduction of quantities used for seed and animal feed

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, calculating the agricultural production index (1/5)

- The quantities are weighted using:
 - **the average international prices** of commodities for the reference period
- Periods considered:
 - **periods not subject to specific shocks** (poor rainfall, storms, etc.)
- To lessen the specific effects of each year in the reference period, put:
 - as the numerator: the aggregate divided by the average aggregate for the reference period 2004-2006

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, calculating the agricultural production index (2/5)

- **Data used:**

- agricultural production for a given calendar year
- livestock production (including the meat equivalent of live animals exported and excluding the meat equivalent of live animals imported) for the meat production index
- Annual changes in the number of animals and poultry or their average live weight **are excluded** from the calculation

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, calculating the agricultural production index (3/5)

- **Scope:**
 - **Products included:**
 - All the products of crops and livestock in each country except forage
 - Products considered edible which contain nutrients
 - **Products excluded:**
 - Coffee and tea are excluded as they have virtually no nutrient value
 - Primary agricultural commodities (or seed) intended for animal feed (e.g. maize, potatoes, milk, etc.)
 - Forage
- **FAO hypothesis:** agriculture regarded as a single enterprise:
 - seed and animal feed quantities are subtracted from the production data so they are not counted twice (in production and as intermediate consumption for new productions)

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, calculating the agricultural production index (4/5)

- Causes of probable differences between FAO indexes and country indexes
 - Concepts (products, etc.)
 - Cover
 - Weighting
 - Reference period considered
 - Calculation methods

4.4-2 Agricultural prices and price indexes: examples of useful composite indexes, calculating the agricultural production index (5/5)

- Calculation of international prices: **Geary-Khamis formula** for the agricultural sector
- This method assigns a single "price" to each product
- The monetary unit in which prices are expressed has no influence on the published indexes

Exercises

- **Exercise 27: Collection of agricultural prices using non-conventional units**
- **Exercise 28: Farmgate prices collection method**
- **Exercise 29: Composite indexes and graduation**



4.5

Food security and food balance sheet

4.5-1-Food security and food balance sheet: Food security (1/3)

- Definition
 - **Food security** is a situation in which all members of a household **at all times are consuming enough safe and nutritious** food for normal growth and development, and for an active and healthy life
- Five dimensions of food security:
 - 1) availability
 - 2) accessibility
 - 3) stability
 - 4) food quality
 - 5) right to food

4.5-1-Food security and food balance sheet: Food security (2/3)

- It has 4 interacting dimensions, which are:
 - 1) **availability**: all the food resources produced, stored or imported for a given period
 - 2) **accessibility**: ways and means whereby households can obtain the food products they need
 - 3) **stability**: implies regularity of food availability in terms of both time and space

4.5-1-Food security and food balance sheet: Food security (3/3)

- 4) **Food use:** assumes that all individuals have a food intake which meets their needs in quantity and quality
 - Here this concept reflects **nutritional quality** which, if it is too low, can result in malnutrition

4.5-2-Food security and food balance sheet: Food balance sheet, definition and purpose

- **Purpose**

- To provide a framework for recording measurable variables and figures concerning the food situation in a country

- **Definition:** Objective method of:

- assessing food availability
- estimating food deficits and surpluses
- determining whether extra imports and/or aid are necessary to bridge the gaps or dispose of harvest surpluses

4.5-2-Food security and food balance sheet: Food balance sheet, features

- **Features: the food balance sheet**
 - needs to take into account all potentially edible products (consumed by humans or used for non-food purposes).
They are:
 - basic commodities
 - processed products
 - reflects variations between uses and resources
 - resources: a list of the products to be considered and sources stating the origins
 - uses: utilization of these products

4.5-2-Food security and food balance sheet: Food balance sheet, data to be collected (1/3)

- **Reference period:**
 - The food balance sheet covers the calendar year (from 1 January to 31 December of the year in question)
- **Primary data**
 - Rainfed crops
 - Irrigated (horticultural) crops
 - Sugar crops
 - Fruit production
 - Livestock, poultry and fishery production
- **Industrial production data**

4.5-2-Food security and food balance sheet: Food balance sheet, data to be collected (2/3)

- **Other data:**
 - external trade data
 - data on stocks
- **Data on primary consumption**
 - the potential products for drawing up a food balance sheet are summarized in the following table:

4.5-2-Food security and food balance sheet: Food balance sheet, data to be collected (3/3)

Potential products in a food balance sheet

| Category | Product |
|---------------------------------------|---|
| Cereals | Millet, sorghum, maize, fonio, rice, wheat |
| Pulses | Cowpea, bambara nut |
| Oilcrops | Soybean, groundnut, cottonseed, sesame seed |
| Tubers and roots | Yam, sweet potato, manioc, potato |
| Kitchen garden products | Onion, cabbage, local aubergine, purple aubergine |
| Fruit | Banana, mango, citrus fruit |
| Sugar crops | Sugar cane |
| Vegetable oils | Peanut oil, cottonseed oil, soybean oil, sesame seed oil |
| Meat | Bovine meat, sheep meat, goat meat, pig meat, poultry, other meat and offal |
| Aquaculture/fishery products | Fish, crustaceans, etc. |
| Sweetener | Sugar |
| Animal fats | Butter |
| Milk and dairy products | |
| Eggs | |
| Alcoholic and non-alcoholic beverages | |

NB: Each country will adapt these categories and products as appropriate

4.5-2-Food balance sheet: internal availability and uses (1/2)

- Type of chart for estimating internal availability and uses

| ITEMS | VALUE |
|--|-------|
| Population | |
| Internal availability | |
| <ul style="list-style-type: none">○ Gross production○ Changes in stocks (closing stock – opening stock)○ Trade balance (Imports (including food aid) - Exports) | |
| Internal consumption | |
| <ul style="list-style-type: none">○ Food○ Processing for food○ Food for tourists○ Feed○ Seed○ Losses○ Industrial use○ Residual and Other uses | |
| Availability/inhabitant | |

4.5-2-Food balance sheet: internal availability and uses (2/2)

- Type of chart for estimating availability and total uses

| As resources, record : | As uses, record: |
|---|--|
| <ul style="list-style-type: none">- Net agricultural production (plant and livestock)- Stocks at the beginning of the financial year- Imports- Food aid (normally included in imports) | <ul style="list-style-type: none">- Food consumption- Processing for food- Food for tourists- Feed- Seed- Losses- Industrial use- Stocks at the end of the financial year- Exports- Residual and Other uses |

- The items shown in the balance sheet are aggregate items

4.5-2-Food balance sheet: key definitions

Production (1/2)

- **Production** comprises total internal production including
 - non-commercial production
 - kitchen garden production
- Unless stated otherwise, production is **measured** on the holding **for plant and livestock products** (i.e. in the case of crops, not counting harvest losses)

4.5-2-Food balance sheet: key definitions

Production (2/2)

- **Plant production**

- any food product derived from a plant (cereals, pulses, tubers, vegetables, fruit, etc.)

- **Livestock production**

- any food product derived from animals (meat, fish, eggs, milk and dairy products, honey, etc.).
 - As regards fish: it refers to fishery products and it is the actual ex-water weight of the catch at the time of capture that is considered
 - As regards meat: the statistics are expressed in terms of carcass weight

4.5-2-Food balance sheet: key definitions

Imports and Exports

- **Imports:** include
 - all foods coming from **outside the country** intended for **human consumption**
 - trade exchanges
 - food aid granted on specific terms
 - donations
 - estimates of unrecorded trade
 - **N.B.:** Imports of processed products are expressed in terms of their basic commodity equivalent
- **Exports:** include
 - all movement of foods outside the country
 - **N.B.:** Exports of processed foods are expressed in terms of their basic commodity equivalent

4.5-2-Food balance sheet: key definitions

Re-exports and Food aid

- **Re-exports:**

- Unofficial re-exports distort the figures
- They can be estimated using methods of analysing the informal economy

- **Food aid and donations:**

- All foods coming from outside in the form of aid or donations
 - emergency aid
 - planned aid

4.5-2-Food balance sheet: key definitions

Stocks (1/2)

- **Stocks:**

- are defined as the total quantity allocated for storage of a product for use at a future time (the anticipated future use is not important)
- can be held by a variety of stakeholders:
 - governments
 - manufacturers
 - importers
 - exporters
 - wholesalers
 - farmers
- are at **any level** in the supply chain **except** retail sale

4.5-2-Food balance sheet: key definitions

Stocks (2/2)

- can be counted in two ways as part of the supply-utilization account
 - By reporting on the left and right of the equation, respectively, stock levels at the beginning and end of the period
 - By estimating changes in stocks from one period to the next as a component of supply
 - ✓ In other words, if **closing stocks are smaller than opening stocks**, then some have been removed during the period, thus increasing supplies
 - ✓ In the opposite case, extra stocks have been created as production and the trade balance were sufficient to cover needs

4.5-2-Food balance sheet: key definitions

Changes in stocks

- **Changes in stocks:**

- visible at the beginning and end of the reference period
- occur at all levels between production and retail marketing
- also include fluctuations in:
 - government stocks
 - government trade services
 - stocks with manufacturers
 - milling and processing industries
 - importers
 - exporters
 - other wholesalers and retailers
 - transport and storage enterprise stocks
 - stocks held by producers (farmers' stocks)
- Changes in stocks = final stock – initial stock

4.5-2-Food balance sheet: key definitions

Internal consumption

- **Internal consumption (or needs):** this comprises
 - Food
 - Consumption by tourists
 - Processing for food (e.g. sugar, fats)
 - Feed
 - Seed
 - Industrial use (e.g. oil to make soap)
 - Losses
 - Residual and other uses
 - ***Use, utilization or internal consumption = Food + Processing + Feed + Seed + Consumption by tourists + Industrial use + Loss + Residual and Other uses***

4.5-2-Food balance sheet: key definitions

Domestic use (1/6)

- Domestic use has 8 components:

1) Human consumption:

- Part of production
 - ✓ gross, processed or semi-processed
 - ✓ available for human consumption during the given reference period
- Or quantity of food available for consumption at the level of retail trade
 - ✓ This is goods available for consumption
 - in households
 - in restaurants
 - in institutions

4.5-2-Food balance sheet: key definitions

Domestic use (2/6)

2) Food processing refers to:

- **derived products** (quantities of a food processed into a different **edible** food)
 - ✓ Either belonging to the same food group as the basic commodity (e.g. tomatoes processed into tomato paste)
 - Food processing variable **absent** from the final food balance sheet to avoid double counting
 - ✓ Or allocated to different groups (e.g. barley processed into beer and aggregated into an alcoholic beverages category and not into the barley balance)
 - Processing variable present in the final account
- Quantities devoted to the manufacture of **non-edible** products (e.g. soap or biofuels) are excluded
 - ✓ These are included under **industrial utilization**

4.5-2-Food balance sheet: key definitions

Domestic use (3/6)

3) Feed: part of gross production intended to feed animals

4) Seed:

- part of gross production set aside for sowing
- **estimated by imputation** because most countries have no official estimates
 - ✓ Imputation process in countries with reliable estimates of the cropping area
 - Seeds used = product of
 - average rate of seeding (the quantity of seeds necessary for a given seeded area)
 - area seeded the following year (as the seeds used in year t are set aside and **actually used** for seeding in **year $t + 1$**).

4.5-2-Food balance sheet: key definitions

Domestic use (4/6)

5) Food for tourists:

- quantity of food available for consumption by visitors
- includes consumption by seasonal migrant workers
- It is estimated
 - ✓ by determining the number of incoming visitors in a given country
 - ✓ in net terms (quantity of food available for incoming visitors – quantity of food available for outgoing travellers)
 - ✓ Obtained by imputation using:
 - the number of visitors
 - visit lengths
 - quantity of calories historically available in the country of origin and the destination country
 - Sources of these data: official and semi-official

4.5-2-Food balance sheet: key definitions

Domestic use (5/6)

6) Industrial use:

- this refers to the use of food products in any non-food sector
 - ✓ Examples:
 - Maize, rapeseed for the production of biofuel
 - Palm oil, shea butter for the production of cosmetic products
- FAO guidelines: practitioners should
 - ✓ first find industry and product experts (public and private sectors)
 - ✓ then determine which products are used for industrial purposes in the experts' own countries
 - ✓ finally determine how the use of these products can be modelled in the event of missing data

4.5-2-Food balance sheet: key definitions

Domestic use (6/6)

7) Post-harvest losses: see 4.3

8) Residual and other uses:

- this is calculated according to a country's needs
 - ✓ Some countries calculate this heading *ex-post* as a **balancing item** in the supply-utilization account
 - It is therefore estimated in a similar manner to the “imbalance” in “supply = utilization”, after quantities have been estimated for each of the other variables
 - FAO guidelines
 - this strategy should be used only if imbalances in the equation are small
 - ✓ Some countries can, moreover, remove this heading from the supply-utilization account

Exercise

- **Exercise 30: Food balance sheet**

THANK YOU