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Preparation of frames and mapping

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Introduction

- The construction of the frame is one of the most important preparatory activities for an AC.
- The AC frame is essential for organizational purposes and for ensuring the proper coverage of all agricultural holdings during data collection.
- For censuses that involve sample enumeration, a sampling frame has to be constructed for each sampling selection stage and a non-zero probability of selection has to be assigned to each sampling unit.

Definition of a frame (1)

- A frame can be defined as the set of source materials from which the sample is selected (UNSD, 2005). It is the basis for identifying all statistical units to be enumerated in a statistical collection.
- In the case of AC, the basic statistical unit to be enumerated is the agricultural holding (AH). An ideal frame would be a list of all AHs, based on the operational definition of the AH adopted by the country, identifying each unit without omission or duplication and without including any other units.

Definition of a frame (2)

- WCA 2020 defines two types of AHs:
 - (i) AHs in the household sector – that is, those operated by household members; and
 - (ii) AHs in the non-household sector, such as corporations and government institutions.
- Therefore, the requirements for building a frame may vary depending on AHs in the household sector or AHs in non-household sector.

Types of frames

- **The List Frame** is a list of AHs and/or households. However, when the list of AHs and/or households is missing, the list of EAs could serve as a starting point for the development of a census frame.
- **The Area Frame** is a set of land elements, which may be either points or segments of land.
- **The Multiple Frame**, in which part of the population is covered by a list frame (e.g. special AHs) and the remainder (e.g. other AHs) by an area frame.

Sources of information for the construction of an AC frame

- The statistical data and maps of the EAs of the most recent Population and Housing Census (PHC) and a list of EAs along with their number of households/housing units.
- The statistical data and maps of the EAs of the latest AC including a list of EAs with their number of AHs.
- Statistical farm registers, cadastral and other cartographic materials, other statistical and administrative data sources, which include listings of AHs and/or holders' addresses or their approximate location.
- It might be necessary, due to lack of reliable information, to prepare the census frame by conducting a **listing operation** (prior to starting the enumeration of the AHs).

Frame requirements for all census modalities

- Whatever the census modality, a suitable frame is necessary to ensure full coverage of all AHs in the country.
- It is necessary to estimate in advance the approximate location of holders' housing units and to assign to census enumerators well defined areas of work.
- Commonly, the total area of the country is unambiguously divided into identifiable areas (EAs) in such a way that the enumerators' workloads are approximately equal.
- In many cases, particularly in developing countries, an AC frame is a list of EAs, with the estimated number of AHs in each EA.

Requirements: EAs (1)

- EAs constitute a complete subdivision of the land, with no overlapping, covering all holders' housing units or AHs headquarters.
- The boundaries of an EA should not cross urban, rural or political subdivisions of the country; and preferably the EA should have recognizable permanent physical boundaries.
- An EA should be a compact piece of land, so that an enumerator can walk or travel between any two points without crossing its boundaries. In particular, a large river should never cross an EA; and
- Their area should correspond to approximately equivalent workloads weighting:
 - The approximate number of AHs
 - The distances and difficulties of access to the holders' housing unit or AH headquarter
 - The average time needed for each interview and the established length of the census enumeration period.

Requirements: EAs (2)

- It is preferable that the EAs be small in size, say few hundreds of AHs. In such cases, the AHs will be visible from one point or will be located along a road.
- If large EAs are used, a better plan of enumeration is needed, as some AHs may be enumerated twice while others may be omitted.
- The census EA could be defined as a village or subdivisions of relatively small administrative/political divisions, if good maps are available.
- In other countries, the latest PHC enumeration areas can be grouped to form AC EAs.
- Whenever possible, it is advisable to coordinate the construction of the EAs of the PHC and AC, or to elaborate them jointly.

Specific frame requirements for various census modalities (1)

- When **complete enumeration** is implemented, a set of material providing a preliminary frame will be enough to organize the field data collection.
- When **sampling** is involved the frame requirement is directly related to the type of sampling used.
- **Frame requirement for a classical census**
 - In case of complete enumeration, some frame material is needed in order to properly plan the data collection. This will allow estimating the approximate location of holders' housing units and assigning to census enumerators well defined areas of work.
 - Establish a sampling frame (when sampling is used).

Frame requirements for various census modalities (2)

- **Frame requirement for a modular census**

- As for the classical census, an initial frame of AHs in the household sector (or EAs) and non-household sector is needed to conduct the complete enumeration for the core module (CM).
- The CM should provide the necessary information for building appropriate sampling frame(s) for the subsequent supplementary module(s), SM(s).
- A built-in process should be developed for generating sampling frame(s) for SM(s), according to the design(s) decided.

- **Frame requirement for an integrated census and survey modality**

- As for the classical census, an initial frame is needed for organizing the complete enumeration for the AC CM.
- The frame requirements for rotating sample modules are similar to those for SM of the modular census.

- **Frame requirement: modality based on use of registers as a source of AC data**

- The frame requirements for the field operation component are identical to those discussed in the modalities above.

Some guidelines on building frames for AC (1)

- **To be able to enumerate all AHs** a preliminary frame is indispensable. It is made of a set of physical materials (cartographic maps, EA maps, etc.).
- **When PHC does not include specific questions** on agriculture, the *economic activity status* must be considered together with *occupation* and *industry* in order to provide an approximation for households involved in own-account agricultural production.
- **The minimum data items** recommended in the PHC to better identify such households are: **(i)** *whether the household is engaged in any form of own-account agriculture production*; **(ii)** *measure of farm size, e.g. area of land & the number of livestock*.
- **Use of farm registers & other statistical/administrative** sources to build a frame.
- **Preparation of sampling frames** corresponding to each sample selection stage, including detailed mapping to support the field data collection (when sampling is used). The frame requirement is directly related to the type of sampling.

Some guidelines on building frames for AC (2)

- **The Handbook on Master Sampling Frames for Agricultural Statistics** (Global Strategy, 2015, available at <http://gsars.org/en/handbook-on-master-sampling-frames-for-agricultural-statistics/>) provides detailed guidelines and country examples on the development of AC frames.
- **Using new technology for building frames**, e.g.: GPS, GIS, Remote Sensing.
- **List frame:**
 - Are the most widely used frames for agricultural censuses.
 - Use of PHC data, AC and/or of registers to build a list frame.
 - These are discussed in Chapter 5 of the Global Strategy, 2015.
 - When sampling is involved in the AC:
 - The use of EAs from a PHC or the use of EAs from the latest AC as primary sampling units (PSUs) is a usual form of cluster sampling.
 - In a two-stage cluster sampling, for example, all AHs are listed within PSUs (selected EAs) and a sample of AHs (as represented by holders) is selected in the second and final stage.

Some guidelines on building frames for AC (3)

- **Area frames**
 - The main types of sampling units in area frame: segments, points, transects.
 - These are discussed in Chapter 6 of the Global Strategy (GS), 2015.
- **Multiple frames**
 - Multiple frame sampling involves the joint use of area and list frames.
 - Any duplication (overlap) of list frame elements in the area frame must be removed, an operation that requires special attention and resources.
 - These are discussed in Chapter 7 of the GS, 2015.

Use of thresholds in the AC (1)

- As discussed in WCA 2020, Vol.1 (Chapter 6), in many countries, a **minimum size limit** (MSL) is adopted for AHs included in the census.
- The rationale is that generally, there is a **large number of very small AHs which make a marginal contribution** to total agricultural production but whose inclusion in the AC greatly increases the workload and budget.
- Reliable information about agricultural producers to ensure that **only the units with little contribution** to total agricultural production are excluded from the AC.
- MSLs could be set up well **in advance** of the census, based on data from previous ACs, farm registers and other relevant statistical and admin. data sources, or on the results of the listing operation conducted in the **pre-census phase**. In the latter case, relevant information related to AH's size should be included in the listing.
- When the **listing phase** is combined with census enumeration (starting from a list of households), some initial questions are needed to screen out those that are not AHs.

Use of thresholds in the census (2)

- Various criteria may be used to establish MSLs, such as those regarding AHs:
 - *operated land and livestock raised, e.g. total area of holding or area by major land use types; total number of livestock by main types and/or over certain age*
 - *inputs, e.g. quantity of labour used*
 - *output, e.g. value of agricultural production, value of sales, quantity of produce sold*
 - *purpose of production*; in such a case, the census scope could be restricted to commercial agricultural activities, omitting subsistence holdings.
- One or a combination of such criteria could be used to set MSLs. However, complex thresholds should be avoided. The MSL should be clearly stated, known both to census personnel, respondents and users, and specified in the census report to help the interpretation and analysis of census results.

Use of thresholds in the census (3)

- Small AHs are often a **significant part** of the agricultural sector and without information on such holdings a complete picture cannot be provided.
- A number of countries, **do not apply any minimum size limits or adopt a very low threshold** for defining eligible AHs.
- Countries that exclude small AHs from complete enumeration are strongly urged to set the minimum size limit **as low as possible** and to consider the collection of data through **dedicated sample surveys** for the AHs which are below the threshold.

Country example: Thresholds

Mauritius – Agricultural Census 2014 (1)

- The AC covered both the holdings:
 - in the household sector, or “agricultural businesses” (namely corporations, NGOs, government institutions etc.) and
 - in the non-household sector.

- In the household sector, a distinction was made between:
 - “household farms” and
 - “private households”.

- The AC 2014 was conducted in three phases, depending on the type of the holding:
 - (i) for agricultural businesses, from July to December 2014;
 - (ii) for “household farms”, from July to September 2014 (using a long form); and
 - (iii) for “private households”, from October to November 2014 (using a short form).

Country example: Thresholds

Mauritius – Agricultural Census 2014 (2)

The following thresholds were established for a “household farm” (included in Phase II of the census):

- any household cultivating a piece of land, on own account, and for commercial production (at least five perches);
- any housing unit having a kitchen garden (at least five perches);
- any housing unit having fruit trees on the premises with a certain cut-off: breadfruit, lychee, mango (at least five trees), lemon, mandarin, coconut, guava, other citrus, mixed fruit trees (at least ten trees), banana, pawpaw (at least 20 trees), pineapple, lychee, vegetables, fruits-other, crops-other (at least five perches);
- all honey producers and all deer farms; and
- all units raising livestock (including poultry).

The holdings below the thresholds were classified as “private households” and were covered in Phase III of the census.

Purpose of maps

- **Census planning and frame preparation**
 - Provide the cartographic base for planning (including budget estimation of) the census.
 - The cartographic material used are usually small-scale topographic maps, at scales of 1/50,000, 1/100,000 or smaller.
 - For a sample enumeration it can be used to improve sample design by providing information for stratification and other auxiliary information.
- **Organization, conduct and supervision of field data collection**
 - Maps (or sketches) are used to organize the fieldwork.
 - These are large-scale field maps, 1/10,000, 1/5,000 or larger, which should help the enumerator locate the agricultural holders or holdings' addresses.
 - GIS provides a computer-based design of EAs and significant automation of map production tasks.
 - The use of maps should be an essential part of the enumerators' training.
- **Presentation and analysis of census results**

Types of maps

- Topographic maps, road maps, cadastral maps, administrative area maps, maps showing the population distribution, aerial photographs and orto-photos, satellite images, space photographs, land cover and land use maps, soil or geologic maps, etc.
- PHC EA maps in the form of sketches or digitized and geo-referenced are also frequently used to help delineate the enumerators' areas of work.

Cartographic work

- **The cartographic work** should be undertaken early in the preparatory census activities. The work should be performed by cartographers and GIS specialists who are part of the core staff of the central AC office.
- **It should start with the inventory** of available geospatial information and maps and the evaluation of their suitability for AC purposes.
- **A large proportion of the cartographic** preparations for an AC consists of delineating and identifying the EAs of work.
- **In many countries EA maps** are prepared as part of the cartographic work of the PHC. In some countries the cartographic work is conducted for both PHC and AC (e.g. Brazil).
- **Adapting, revising and updating** available maps to the census requirements.

Country example: Frame

Mauritius – Agricultural Census 2014

- The frame for the holdings in the non-household sector consisted of a list of agricultural establishments obtained from:
 - the Ministry of Agro Industry and Food Security (MAIFS);
 - the Food and Agricultural Research and Extension Institute (FAREI);
 - other administrative sources.
- The sampling frame for the holdings in the household sector was built based on:
 - administrative data sources (from the FAREI databases and the list of small farmers registered with the Small Farmer's Welfare Fund (SFWF) who are engaged in crop and livestock production;
 - the information collected in the 2011 Housing and Population Census.



THANK YOU!