



# Improving Efficiency of Agricultural Census and Survey Design

Near East Regional Workshop - Linking Population and Housing Censuses with Agricultural Censuses. **Amman, Jordan, 24 - 28 June 2012**



Global Strategy  
IMPROVING AG-STATISTICS



## Sampling in Agricultural Censuses

- Sampling is a key element in the new approach recommended by the FAO World Programme for Census of Agriculture 2010,
- Recommended to be used to collect detailed data for those supplementary census modules which are relevant to the country.
- Sampling is a powerful statistical tool that can be used to provide good quality estimates at a lower cost than a complete enumeration



## Sampling in Agricultural Censuses

- Agricultural data collected during population and housing censuses can be used for designing samples for agricultural censuses supplementary modules
- In previous sessions we have considered the ways of using these data for creating sampling frames.
- In the present session we will consider the ways of using these data for improving sample design



# Main types of sampling design

- One-stage sampling
  - ✓ Sampling units (SUs, usually farm households) are selected from the list of SUs created during the population census
- Two-stage sampling
  - ✓ At the first stage, primary sampling units (PPSs, usually population census EAs) are selected
  - ✓ At the second stage, secondary sampling units (SSUs, usually farm households identified during the population census) are selected



# Ways of using data collected during population census for improving sample design

- Stratification
  - ✓ SUs in one stage sampling
  - ✓ PSUs in two-stage sampling
  - ✓ SSUs within PSUs in two-stage sampling
- Allocation of the sample across strata
- Establishing optimal sample size
  - ✓ Overall sample size in one-stage sampling
  - ✓ Number of PSUs in two-stage sampling
  - ✓ Optimal number of SSUs per PSU in two-stage sampling
- Probability-proportional-to-size (PPS) sampling



# Stratification

- Stratification means splitting the population of sampling units into several groups (strata) and drawing samples in those groups separately
- Stratification may be used for increasing precision of sample estimates)
  - ✓ The population is split into different size groups according a characteristics(stratification variable) of sampling units (e.g. into very large, large, medium and small)
  - ✓ Different sampling fractions are applied to different groups (larger fractions to larger groups; the very large group may be even sampled completely)



# Stratification

Stratification of farm households  
(either in one stage sampling or within  
selected PSUs in two stage sampling)

- Additional agriculture-related questions  
(supplementary data items) provide variables for  
stratification
  - ✓ Area of agricultural land (maybe by various land use  
types)
  - ✓ Number of plots
  - ✓ Number of various types of livestock
  - ✓ Number of trees



# Stratification

## Stratification of PSUs in two stage sampling

- Even conventional population census may be useful
  - ✓ PSUs may be stratified according (incomplete) number of farm households revealed according to occupation data
- Additional agriculture-related questions
  - ✓ Core data items can provide complete number of farm households
  - ✓ Supplementary data items can provide more variables for stratification (preliminarily aggregated at PSU level)
    - Area of agricultural land (maybe by various land use types)
    - Number of plots
    - Number of various types of livestock
    - Number of trees





## Allocation of sample across strata

- There are several types of allocation
  - ✓ Equal allocation
  - ✓ Proportional allocation
  - ✓ Power allocation
  - ✓ Optimal allocation
- Equal allocation is straightforward and does not need additional information



## Allocation of sample across strata

### Proportional and Power allocations

- For these types of allocation, a special characteristic  $x$  (called stratum size) is needed for each stratum. Then the total sample size is allocated:
  - ✓ Proportionally to  $x$  for proportional allocation
  - ✓ Proportionally to  $x^\lambda$  for power allocation with  $\lambda$  between 0 and 1 (usually  $\lambda=1/2$ )
- Stratum size may be
  - ✓ Number of sampling units in the stratum
  - ✓ Aggregated area of agricultural land (maybe by various land use types)
  - ✓ Aggregated number of various types of livestock
  - ✓ Aggregated number of trees



## Allocation of sample across strata

### Optimal allocation (also known as Neyman's optimal allocation)

- For this allocation, variances of a characteristic of the sampling units are needed for each stratum. Then the total sample size is allocated according to the formula:

$$n_h = n \frac{N_h S_h}{\sum_h N_h S_h}$$

- The characteristic of the sampling unit may be
  - ✓ Area of agricultural land (maybe by various land use types)
  - ✓ Number of plots
  - ✓ Aggregated number of various types of livestock
  - ✓ Aggregated number of trees



## Establishing optimal sample size

- Optimal sample size of final sampling units (in both one-stage and two-stage sampling), based on existing financial constraints and required precision of estimates, may be established based on variances of characteristics of sampling units (usually farm households). These characteristics may be
  - ✓ Area of agricultural land (maybe by various land use types)
  - ✓ Number of plots
  - ✓ Number of various types of livestock
  - ✓ Number of trees



## Establishing optimal sample size

- Optimal sample size of SSUs per PSU in two-stage sampling may be established based on variances of characteristics of SSUs within and between PSUs (Eas). These characteristics may be
  - ✓ Area of agricultural land (maybe by various land use types)
  - ✓ Number of plots
  - ✓ Number of various types of livestock
  - ✓ Number of trees
- In Uganda agricultural census of 2007, this approach based on user of 2002 population census data on number of plots, allowed to reduce the overall sample size from preliminary planned 48000 to 36000, that is, by 25%.



# PPS sampling

- In two stage sampling, selection of PSUs with PPS increases the efficiency of the sample. For PPS sampling a size characteristics of the PPU (EA) is needed. This may be:
  - ✓ Number of SSUs units in the PSU
  - ✓ Aggregated area of agricultural land (maybe by various land use types)
  - ✓ Aggregated number of various types of livestock
  - ✓ Aggregated number of trees
- PPS sampling was used in Burkina Faso agricultural census 2007 based on data obtained from the agricultural module in the population and housing census





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# THANK YOU!

