Guidelines for Linking Population and Housing Censuses with Agricultural Censuses

with selected country practices

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ACKNOWLEDGEMENT

PREFACE

The *FAO World Programme for the Census of Agriculture 2010* (WCA 2010) strongly recommends that countries consider the option of coordinating the agricultural census with the population and housing census, during the early stages of census planning, in line with the *Principles and Recommendations for Population and Housing Censuses, Revision 2* (UNSD, 2008).

FAO in collaboration with UNFPA and with initial support of PARIS21 have prepared this technical document in order to provide practical guidelines to countries on modalities for coordinating and linking the two censuses, which can be a key element in a cost-effective census strategy. These guidelines have been based on both WCA 2010 and a detailed review of the collection of agricultural data in the population and housing census in various countries around the world. FAO's extensive experience in providing support to agricultural censuses in all regions of the world is drawn on. It also takes into account UNFPA's experience in supporting population and housing censuses.

Integrating the population and housing census with the agricultural census is consistent with the *Global Strategy to Improve Agricultural and Rural Statistics* (World Bank *et al.*, 2011). One of the three pillars of the strategy is the integration of agricultural statistics into the national statistical system. At the operational level this integration is to be achieved through: (1) an integrated survey framework; (2) development of a master sample frame for agriculture; and (3) an integrated data management system. Experience shows that collecting limited and well-defined agricultural data during the population and housing census can substantially contribute to building an efficient master frame for agricultural censuses and surveys in many developing countries.

At the operational level, linking the population and housing census with the agricultural census is more suitable for countries where both censuses are carried out as a household enquiry. In countries where the agricultural census is based on other approaches, for instance an area frame survey or administrative records, linking population data with agricultural data -even after the censuses- may be a more appropriate option.

Our aim here is to provide practical guidance for population and housing census and agricultural census planners looking to implement a cost-effective census strategy by coordinating the population and housing census with the agricultural census.

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ABBREVIATIONS

CPC	Central Product Classification
EA	Census Enumeration Area
FAO	Food and Agriculture Organization of the United Nations
GCA	General Census of Agriculture
GPS	Global Positioning System
IHSN	International Household Survey Network
ISIC	International Standard Industrial Classification of Economic Activities
ILO	International Labour Organization
PARIS21	Partnership in Statistics for Development in the 21st Century
PPS	Probability Proportional to Size sampling
PSU	Primary Sampling Unit
RGPH	Recensement General de la Population et de l'Habitat
SNA	System of National Accounts
SSU	Secondary Sampling Unit
UNECA	United Nations Economic Commission for Africa
UNECE	United Nations Economic Commission for Europe
UNFPA	United Nations Population Fund
UNSD	United Nations Statistics Division
UNSC	United Nations Statistical Commission
WCA 2010	World Programme for the Census of Agriculture 2010

Chapter 1
INTRODUCTION

"While the population and housing censuses have a close relationship, their relationship with the agricultural census is less well defined. However, as the result of increasing integration within programmes of data collection, the relationship between the population and housing census and the agricultural census is now far closer than in the past, and countries are increasingly looking at new ways to strengthen this relationship"

(UNSD, 2008, Paragraph 1.44)

The population and housing census has a key role to play in an integrated national statistical programme (including agricultural statistics) - as a source of information about human capital and as an instrument for providing a sample frame for subsequent surveys in many sectors. It has long been argued that the two censuses cannot be combined or linked very easily since the enumeration units are different. The population and housing census uses the household as its basic unit while the agricultural census uses the agricultural holding. On the other hand, in actual practice, the units are the same in many cases. A vast majority of agricultural holdings, particularly in developing countries, are managed by households or members of households, either singly or jointly. One illustration of this point comes from the 1997 agricultural census in China in which 193 million household holdings were recorded, in contrast with 358 000 – fewer than 0.25 percent - non-household holdings. This pattern is likely to be even more pronounced for urban and peri-urban agriculture increasingly found among urban populations.

The unit common to the agricultural census and the population and housing census is therefore the household engaged in agricultural activities or farm household, defined in the glossary and explained in detail below. The important thing to note is that it is this enumeration unit of the household which enables the two censuses to be linked. This provides considerable scope for carrying out the preliminary work for the agricultural census during the population and housing census. Integrating agricultural statistics with population statistics has obvious advantages for policy-making in enabling a wider range of analysis – including demography, education, migration, living standards and occupation with agriculture - thus enabling a more complete national picture to emerge. It is therefore important that a population and housing census include questions to identify farm households, and such examples are included in this guideline.

Experience shows that, in many countries, linking the population and housing census with the agricultural census can result in the advantages for the national statistical system listed below.

Reducing the total cost of the two censuses: Considerable economies can be made by adopting a coordinated approach for both censuses, when feasible, rather than conducting them entirely separately. Collecting basic agricultural data during the population and housing census means that the same infrastructure,

logistics, personnel and equipment can be used for both censuses. Some countries have experienced up to 50 percent reduction in the cost of the agricultural census by including basic questions in the population and housing census, which enables agricultural households to be identified for building the sample frame.

Reducing the scope of the agricultural census: FAO, in WCA 2010, lists the 16 data items required for complete enumeration in the agricultural census core module. There is the potential to collect a large proportion of these items during the population and housing census. Any separate agricultural census could then be reduced in scale - in some small island countries, this core information alone represents a substantial proportion of the data to be gathered from an agricultural census. Details about demography, livestock, fruit trees and -where possible- the area of temporary crops for all households are particularly useful additional data to gather.

Enriching data analysis from the two censuses: Collecting both sets of data at the same time, or consecutively, enables direct linkages to be made through the unique household identification number. The result is a much richer data set and analysis than is possible through two separate statistical exercises.

Ensuring regular agricultural census operations: Institutionalizing arrangements for conducting the two censuses as an integrated exercise helps to ensure that the census of agriculture is carried out regularly.

Building a reliable sample frame for the agricultural census: Access to an up-to-date and reliable frame of agricultural holdings – including both household and non-household operated holdings - is a major problem for the census of agriculture in many developing countries. Where the majority of the population do not rely on agriculture for their livelihood, the number of agricultural holdings is usually small and the frame can be fairly readily compiled from land and business registers, lists of large farms and other sources. Building a frame of household-operated agricultural holdings is a much larger and more complex task. It effectively means visiting all private households to establish the extent of agricultural activity in each, and how many separate holdings household members are engaged in. The population and housing census provides a unique opportunity for identifying all agricultural households, including in urban areas, for developing an up-to-date, reliable frame as a starting point for agricultural censuses and surveys.

Optimizing the sampling design of the agricultural census: In many developing countries, agricultural censuses are conducted using large samples to generate results at small administrative unit level. Agricultural information collected during the population and housing census can be used to improve sample design: including identifying optimal sample size, and to better stratify and allocate the sample -between strata and between different stages- when multi-stage cluster sampling is used. When probability proportional to size (PPS) is used, the data from the population and housing census can also be used to provide an up-to-date size measure.

Better defining the agricultural census coverage: Minimum size limits, on variables such as numbers of livestock, numbers of trees (tree crops), area of land (temporary crops), value of annual sales, and purpose of production (breeding livestock), are used in most countries to determine whether a household's agricultural activity qualifies as a holding or not. This basic information can be collected during the population and housing census through the standard visitation record or through a separate section in the household questionnaire. The information can also be collected as part of the pre-census cartography and fieldwork. In addition to providing a frame, this has advantages for the design of the agricultural census. For example, after an integrated population and housing census the minimum size criteria can be set at a higher level than has traditionally been the case, as information about the smallest holdings has already been collected and little additional data would be gleaned from administering a further questionnaire to such holdings. Efforts, and resources for data collection, could then be focused on the more productive holdings.

Several countries have successfully collected agricultural data during their population and housing censuses in past rounds. Given these successful country examples from around the world and the advantages indicated above, FAO and other UN agencies have recommended a closer relationship for the 2010 round between the population and housing census and the agricultural census.

The purpose of these guidelines is to provide information to census planners about practical ways of linking the two censuses. In particular, suitable agricultural data items to include in a population and housing census, and suggested questions to elicit those data, are proposed. The guidelines contain the following chapters:

Chapter 2: provides an overview of data related to agriculture in past population and housing census rounds - and their limitations.

Chapter 3: reviews recommendations made by FAO and other UN agencies for coordinating and linking the two censuses.

Chapter 4: looks at best practice from around the world to see how the two censuses have been successfully linked.

Chapter 5: provides suitable agricultural data items and suggests standard questions to be collected in a population and housing census, according to a country's specific context. A standard questionnaire and corresponding instructions are provided in Annex 1.

Chapter 6: illustrates how to build an effective sampling frame for agricultural censuses and surveys, using the agricultural data collected during the population and housing census.

Chapter 7: examines how to improve the efficiency of sampling design for (sample based) agricultural censuses and surveys, using agricultural data collected during the population and housing census.

Chapter 8: provides example tables that can be compiled using agricultural data from the population and housing census.

Chapter 2

LIMITATIONS OF AGRICULTURAL DATA IN PAST POPULATION AND HOUSING CENSUSES

2.1 Data related to agriculture in past population and housing censuses

In most countries, population and housing censuses are based on guidelines issued by the United Nations for each decennial round. Those UN guidelines do not cover agricultural data, although they include items that can be used as a proxy for agricultural labour.

The guidelines in the *2010 World Programme on Population and Housing Censuses* (UNSD, 2008), recommends collection of the following items on labour - based on International Labour Organization (ILO) recommendations:

- Main occupation
- Industry of main occupation
- Employment status in main occupation

Most countries systematically include these items in their population and housing census. The data are collected for each economically active person, defined in terms of either current status or usual status. The current status is based on the activity status of individuals over a short reference period, such as the seven days preceding the survey. Although commonly used, this status has limited use for building a reliable frame for the agricultural census, as discussed below. The usual status is based on the activity status of individuals, based on their main activity over a long reference period.

The occupation of main job and industry of main job can be used, to some extent, to identify persons in agricultural occupations and industries, based on national occupation and industry classifications. While countries such as Indonesia provide a detailed industry breakdown into food crops, plantation crops, fisheries, animal husbandry, and other agricultural activities, in most countries only broad occupation and industry groupings are available.

Status in employment of main job refers to whether the person is an employee, own-account worker, and so on. Individual responses about occupation and industry can be analysed alongside status in employment so as to classify agricultural workers broadly as farmers or agricultural employees. It can also be used as a proxy to identify farm households. A household in which any member has both an agricultural main activity and a status of "own account worker" would be classified as a farm household.

The data collected in this way can be useful in their own right. They also provide proxy information that is useful in designing agricultural censuses and surveys and in creation of a frame. Data gathered about the number of farm households in each Enumeration Area (EA) can serve as a starting point for the listing exercise of sampled EAs, although it usually underestimates the number of agricultural households, and therefore would not provide an entirely accurate list frame. Ways in which the data can be used in census tabulations are discussed in Chapter 7.

However, this traditional way of producing agricultural data has serious limitations when preparing and conducting an agricultural census, as explained below.

2.2 Limitations of agricultural data collected in past population and housing censuses

Population and housing censuses have traditionally focused on basic demographic, social and labour force data. The farm household data obtained indirectly through labour force data usually underestimate the number of agricultural households and produce an inaccurate frame for the agricultural census.

As indicated above, the data are collected for each economically active person, commonly defined using the current status approach, based on a short reference period such as the seven days preceding the survey. This approach is not suited for measuring agricultural labour because of the seasonality of agricultural work. At the time of enumeration, the person may not be engaged in agricultural work even if this is their main activity at other times of the year, resulting in the high probability that some persons working in agriculture may not be identified.

Depending on the criteria used to define the main job, this concept may also exclude farm households in which members are engaged in several activities. This is more likely in urban areas, or in rural households engaged in other activities such as fishing.

A lack of coordination in planning the two census operations may further limit the usefulness of the data for the agricultural census, especially if there is a significant time gap between the two operations, or if the agricultural census precedes the population and housing census. The overall cost for the national statistical system of conducting these two most comprehensive statistical undertakings independently will be far higher than when planning is coordinated.

Countries National Strategies for Development of Statistics and the *Global Strategy to Improve Agricultural and Rural Statistics*, adopted by the international statistical community, both promote an integrated approach to data collection within the national statistical system. The Global Strategy considers that linking the population and housing census with the agricultural census serves to integrate agriculture into the national system, and it recommends building a master sampling frame to conduct integrated agriculture and rural censuses and surveys.

FAO and other UN agencies are therefore encouraging countries to establish a closer relationship between the population and housing census, and the agricultural census. To this end, specific recommendations have been included in the 2010 round.

Chapter 3

RECOMMENDATIONS FOR THE 2010 ROUND OF POPULATION AND HOUSING, AND AGRICULTURAL CENSUSES

In many countries, agriculture is one of the most important sectors of the national economy, and in some places the majority of households are engaged in agricultural production activities such as cultivating crops, raising livestock or growing vegetables on small plots surrounding the house. The importance of these activities to household income and food security should not be underestimated. The close relationship between such agricultural activities and the various population characteristics recorded in the population and housing census means that, in many countries, a strong case can be made for including agricultural items in the population and housing census.

Past recommendations about agricultural data in the population and housing census have been limited. However, the increasing need to integrate data collection programmes (producing more cost-effective data for the national statistical system), and successful experiences of many countries in linking the population and housing census with the census of agriculture, have led FAO and UN agencies to recommend strengthening links between these two types of census in the 2010 round. Their recommendations are summarized below.

3.1   FAO recommendations

In 2005, FAO published guidelines for the 2010 round of agricultural censuses covering the period 2006 to 2015 (FAO, 2005). A new modular approach was adopted (see Figure 1), with a core census module based on complete or large sample enumeration providing a limited range of key structural data, and one or more supplementary sample-based census modules providing more in-depth data.

The programme has several new features, including strong recommendations for coordinating the agricultural census with the population and housing census.

FAO encourages countries to examine all aspects of coordinating the planning of both population and housing, and agricultural, censuses. Seven key aspects of coordination are considered below.

Use of common concepts, definitions and classifications. This has been a feature of previous agricultural census programmes and is again strongly recommended in WCA 2010.

Sharing field materials. The field systems for the two censuses can usually be coordinated, for instance by using the same enumeration areas (EAs) and maps for field work. It is recommended that countries fully explore these possibilities in planning their census operations.

Using the data from the population and housing census as a frame for the agricultural census. FAO encourages countries to use the household lists from the population and housing census as a frame for the agricultural census, where this is suitable. Problems with lists becoming out-of-date and differences in the statistical units for the two censuses (*households*, *farm households* and *agricultural holdings*) are discussed below.

Data related to agriculture to be found in the population and housing census, and their possible use in the agricultural census. FAO demonstrates how standard population and housing census data relating to occupation, industry and status in employment can be used to identify *farm households*. The conceptual shortcomings are highlighted, and countries are advised to consider the extent to which these data are useful in the agricultural context.

Collecting additional agricultural data in the population and housing census. It is suggested that countries consider including additional agricultural topics in the population and housing census, to enable development of frames or compilation of tables.

Linking data from the agricultural census with the population and housing census. FAO encourages countries to link data from the population and housing census with those from the agricultural census, where possible. The benefits in widening the scope of census tabulation are highlighted. The resulting cost savings in data collection are also noted. A list of agricultural census items that might not need to be collected under these circumstances is provided. How to link agricultural census and housing census data is also discussed.

Conducting the two censuses as a joint field operation. FAO guidelines outline how data collection for the population and housing, and agricultural censuses could be carried out as a joint field operation. The statistical and operational benefits and problems are discussed. Countries are encouraged to consider whether a joint field operation would be suitable for their censuses.

FIGURE 1:

The agricultural census as part of an integrated system of censuses and surveys
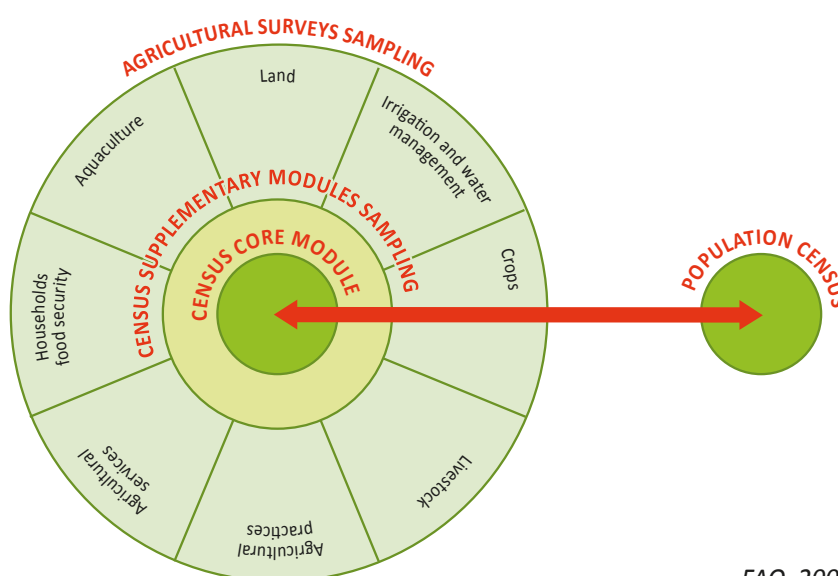
FAO, 2005.

3.2   UN principles and recommendations

The *Principles and Recommendations for Population and Housing Censuses, Revision 2* were adopted by the United Nations Statistical Commission (UNSC) at its 38th session in 2007. The main objective of these is to provide international principles and recommendations for planning and organizing population and housing censuses, for the use of national statistical offices and census officials worldwide.

The recommendations include provisions for using population and housing censuses in an integrated programme of data collection and compilation, and in particular how to relate population and housing censuses to other types of census and statistical investigation. Specific recommendations are made about relating the population and housing census with the census of agriculture. The following is an extract from the UNSD publication (UNSD, 2008, paras 1.44-1.50): "In planning the national census programme, consideration should be given to the possibility of collecting additional agricultural information as part of the population and housing census exercise that would facilitate the preparation of the frame of agricultural holdings in the household sector for a subsequent agricultural census. This could be done as part of the pre-census cartographic work and/or listing exercise or by adding an item to the census questionnaire. In the latter case, a relevant question could be whether any member of the household is engaged in self-employed agricultural production. Alternatively, extra data on individuals could be collected to identify persons involved in agricultural activities during a longer period, such as a year."

Where countries choose to adopt this approach of using the population and housing census to establish a frame for the agricultural census, the latter should be synchronized with the population and housing census and conducted as soon as possible after it, while the frame is still up-to-date.

The opportunity for linking data from the population and housing census with the agricultural census is worth exploring. Linking could add considerable analytical value to data sets from both censuses and also save on data collection costs. Much of the data on demographic and occupational status collected in the population and housing census are also collected in the agricultural census. If data from the two censuses could be linked, it would not be necessary to collect these data again in the agricultural census.

Some countries conduct data collection for the population and housing, and agricultural censuses as a joint field operation. In such cases, each census generally retains its separate identity and uses its own questionnaire but field operations are synchronized so that the two data collections can be done at the same time by the same enumerators. Occasionally, the two censuses are merged into one. This may have a number of advantages but its effect on field operations and data quality needs to be carefully considered. These approaches are discussed below in the context of experiences from countries around the world.

3.3   UNECE recommendations

The *Conference of European Statisticians Recommendations for the 2010 Censuses of Population and Housing* (UNECE, 2006, Paras 42-48, pp. 73-74] specify that, "In planning the population and housing census, every opportunity for developing the relationship between this census and the agricultural census should be explored." Linking these censuses is seen as particularly relevant for countries in which most agricultural activities are conducted in the household sector.

This focus on linking extends through all aspects of the population and housing census, starting from how the agricultural census is designed through to questionnaires, data collection, evaluation and analysis.

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Recommendations at the design phase include using compatible definitions in the population and housing, and agricultural censuses; and using material from the population and housing census to demarcate EAs, prepare the sample frame and the sample design.

Collecting additional agricultural information during the population and housing census - either during a pre-census cartographic listing, or by adding a question to the census – can facilitate the preparation of the sample frame. It is helpful to look at a household's agricultural production for their own consumption (own account agricultural production), and at individual involvement in agricultural activities, synchronising the two censuses so that the agricultural census is conducted while the frame is still up-to-date.

Field operations can be combined so that the two data collections are done at the same time using the same enumerators, although separate questionnaires are issued.

Linking the censuses also adds analytical value to the data sets and avoids duplicate collection of data. For instance, demographic and activity status data are collected in both censuses and this could be avoided.

3.4   UNECA recommendations

The UNECA Africa Addendum, *The 2010 Africa Round of Population and Housing Censuses: Draft Implementation Handbook* (UNECA, 2008, Para 3.6, p. 23) also includes recommendations about linking the population and housing census with the agricultural census: "It may be desired to link the population census with other national censuses/surveys. This may be in sharing logistics (equipment and personnel), sharing information (maps or EA lists) or conducting the exercises jointly. The process of linking serves to enrich data analysis and minimize the cost of data collection. If this is to be done, it should be integrated at the planning stage and the census processes designed in such a way as to take care of these needs."

UNECA suggest including questions about agriculture in the population and housing census, using the population and housing census data as a frame for the farm household, using information from the population and housing census to identify agricultural holdings, and sharing the field enumeration material.

Current guidelines for the population and housing, and agricultural censuses for the 2010 round recommend coordinating the two censuses, assessing areas suitable for linkage. Preparing the frame, linking the two censuses, and using the agricultural data already included in the population and housing census are all addressed. The guidelines also propose agricultural questions suitable for inclusion in a population and housing census, using country examples in which the two censuses have been successfully coordinated. Good practices identified globally are the basis for these general guidelines.

Looking at a range of cases from various countries provides a valuable reference tool for those instances where there is no unique solution to fit a country's situation and little or no relevant theory. The FAO/UNFPA guidelines has been derived from relevant census-related practices worldwide and from the specific country examples presented in Chapter 4 and Annex 4. The relevant practical experience of countries has been standardized into a more general framework. The case studies that follow illustrate the variety of situations faced by countries around the world, and their differing responses according to the context.

Chapter 4

REVIEW OF SELECTED COUNTRY PRACTICES IN LINKING THE POPULATION AND HOUSING CENSUS WITH THE AGRICULTURAL CENSUS

4.1 Country practices in collecting agricultural data in population and housing census

This section summarizes country practices, and assesses the feasibility of extending these methods to other countries. Case details also illustrate the potential for linking censuses in a variety of contexts, including developed and developing countries, small island states, and countries with large or small scale agriculture sectors. A wider range of ways in which different countries collect agricultural data in the population and housing census is to be found in Annex 4[1], along with a list of the population and housing censuses mentioned in the cases.

Different countries link their population and housing census with their agricultural census to varying degrees – which impacts on the extent to which agricultural data are collected through the population and housing census. Approaches to linking the two censuses range from including a few key variables in the main population and housing census questionnaire, to preparing a separate agricultural module, or even jointly conducting the population and housing census with the agricultural census.

4.1.1 Approach: Inclusion of items in the population and housing census

The agricultural data collected in many countries is limited to specific questions, in the main population and housing census questionnaire, to determine whether the household is engaged in agricultural activities.

In the censuses conducted some countries asked questions about agricultural land and operation. Albania asked whether the household owns agricultural land and, if so, whether the household or someone else cultivates it. Nepal asked whether the household owns agricultural land and whether it raises livestock/poultry. Seychelles asked whether the household has farmed or raised any livestock in the last twelve months. Zambia asked whether the household is engaged directly in any agricultural activity. The Occupied Palestinian Territory identified all agricultural holdings operated by the household.

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1   The list is not a complete account of all country practices since it is based on relevant information available to FAO at the time these guidelines were prepared.

Some countries asked about the activities of each household member. Belize asked each household member whether they own land for farming. Fiji asked whether anyone in the household earned money from producing cash crops, raising livestock or fishing. Uganda asked whether any member of the household is engaged in growing crops, rearing livestock, keeping poultry or fish farming. Cyprus asked a similar question. Bangladesh asked for the household's main field of economic activity: namely, agriculture/forestry/animal husbandry, fishing, agricultural labour, etc. Poland asked each member of the household whether he/she is an agricultural holder. Canada asked whether any member of the household is a farm operator.

Fisheries are important in many countries and are often viewed as an element of agricultural activities. Questions in the population and housing census for Fiji, Uganda, Bangladesh and Zambia covered agriculture and fisheries.

Some countries extend data collection in the main population and housing census beyond identifying farm households. The topics covered vary from country to country, and some countries collect a wide range of data – for instance, the agricultural module in Burkina Faso asked about annual crops, fruit trees, sylviculture practices, livestock, fisheries, and machinery owned. Most countries using this approach include the limited key items listed below.

The main agricultural data items included in population and housing censuses are:

- **Agricultural holders**: In addition to identifying agricultural production in the household, agricultural holders are sometimes identified. Characteristics of holders, such as sex and age, can then be determined. This was done in Canada, the Occupied Palestinian Territory and Poland.

- **Farm area or area of agricultural land**: Although data about farm area are seldom collected, Poland collected information about the area of the holding, Nepal asked about the area of agricultural land by land type, and the Occupied Palestinian Territory asked about the area of holding and whether it grows crops, livestock, or is a mixed crop and livestock holding.

- **Crops**: Crop data are commonly collected. Uganda asked whether the household grows crops, and how many pure stand and mixed crop plots there are for each crop type. Papua New Guinea asked whether particular crops are grown. Sierra Leone and Zambia asked for the area of each major crop grown. Mauritius asked for the number of fruit trees of bearing age for each fruit type. Botswana asked whether particular crops are grown.

- **Livestock**: Data about livestock numbers are often included. In Nepal, households were asked to report the total number of livestock and poultry. Cook Islands, Sierra Leone and Zambia collected data about the number of each main type of livestock. Botswana and Papua New Guinea asked whether the household has particular types of livestock.

- **Agricultural machinery**: Cook Islands is alone, among the countries studied, in asking about ownership of agricultural equipment such as tractor and rotary hoe, and fishing equipment such as spear gun and canoe.

- **Type of production system or purpose of production**: Cook Islands asked whether agricultural and fishery activities are mainly subsistence or commercial. Seychelles asked about the main purpose of production (sale or sale of surplus) for both crops and livestock, and whether any crop or livestock produce have been sold. Papua New Guinea asked about the purpose of production for each crop grown and for each livestock type raised. Botswana asked whether any member of the household received cash from the sale of specific agricultural products.

- **Fish ponds**: Uganda was alone in requesting more detailed fisheries data (number of fish ponds).
- **Land tenure**: Cook Islands asked individuals how their land rights were are determined. Botswana asked whether the household owns the agricultural land and how it was acquired.
- **Agricultural labour**: Poland asked each person in farm households how many months they have worked on the farm in the last twelve months.
- **Gender issues in agriculture**: In Nepal, the 2001 population census included questions about the land and livestock owned by female members of the household.

4.1.2   Approach: Extended agricultural module in the population and housing census

In WCA 2010, FAO suggests a modular approach for coordinating the population and housing census with agricultural census field operations. For countries following this approach, most of the agricultural census core module is carried out jointly with the population and housing census, and any supplementary modules are followed up as a separate operation soon afterwards. Burkina Faso has tried out this approach of an extended agricultural module in the population and housing census.

Operationally, this is no different from a jointly conducted population and housing/agricultural census and the same issues of field organization need to be addressed. In addition, separate enumeration for the agricultural module has to be considered.

Pre-census fieldwork is often required to make organizational arrangements for the data collection operation, to prepare maps, and to list households. If the two censuses are conducted at about the same time, the pre-census activities for both can be combined, with obvious cost benefits. This approach also facilitates timely construction of the agricultural census frame, and the linking of census data.

In a typical joint pre-census household listing, each household is asked (one or more) agriculture-related questions to determine whether it engages in any agricultural activities. When the household listing is obtained from local officials, information for the two censuses could be provided at the same time.

> **BOX 1 - BURKINA FASO**
> **Agricultural data items**
>
> *In its 2006 population and housing census, Burkina Faso included an agricultural module to cover the following items:*
>
> - *Types of annual crops by season*
> - *Types of horticultural crops by season*
> - *Number of fruit trees of different types*
> - *Whether the household practises sylviculture*
> - *Whether the household is engaged in fisheries*
> - *Number of livestock by type*
> - *Number of draught animals by type*
> - *Number of items of machinery owned*
>
> *This is consistent with the list of items FAO recommend for the agricultural census core module, and provides a good frame for the agricultural census supplementary modules.*

4.1.3   Approach: Conducting the population and housing census jointly with the agricultural census

In a very few countries, a full-scale agricultural census is conducted jointly with the population and housing census.

Canada is one country that coordinates the data collection for both censuses. This approach enables it to link data from the two censuses, and to make significant savings on data collection costs - as the usual demographic and other data do not need to be collected twice. Additional cost savings can be made by sharing the same enumerators, processing centre and other aspects of collection.

The joint census operation works in Canada only because both censuses are self-enumerated. The census enumerator's job is simply to distribute questionnaires. It would be more difficult if the enumerator had to interview each household to administer the questionnaires. Other countries sometimes carry out census fieldwork by forming teams of enumerators who move from village to village; in these circumstances, an interview-based joint census could be carried out by having separate population and housing, and agricultural census, enumerators in each team.

Other operational difficulties in running a joint population and housing/agricultural census should be acknowledged. It may be difficult to find a suitable time for a joint census because of operational factors. Even in Canada, May is probably not the best time for an agricultural census as it is a busy period for farmers. However, the population and housing census is constrained to May to avoid the school holidays and winter migration of retirees. Countries might also face administrative and organizational problems, especially if different government agencies are responsible for the two censuses.

BOX 2 – CANADA
Jointly conducted agricultural and population censuses

One example of jointly conducting the two censuses is to be found in Statistics Canada's approach. It carries out both agricultural and population censuses as a joint field operation every five years, using the same field staff but maintaining each census as a separate statistical activity. The latest censuses took place in May 2011.

The 2011 censuses were conducted by self-enumeration. In rural areas, a census enumerator visited each household to deliver the census forms. Each household received a population census questionnaire: 80 percent received a short form containing eight basic demographic items, and 20 percent received a long form containing more detailed data.

In addition, the enumerator asked the household the question: Is anyone in the household a farm operator? If the answer was "Yes", an agricultural census questionnaire was left with the household. An agricultural census questionnaire was also left with any household that appeared to be a farm household but could not be interviewed. In urban areas, population census questionnaires were mailed to all households. The population census questionnaire included a similar question to identify farm households in urban areas. Agricultural census questionnaires were not distributed in urban areas. Completed questionnaires for both censuses were mailed back to Statistics Canada or submitted via the Internet.

*A farm operator was defined as "**a person responsible for the management and/or financial decisions made in the production of agricultural commodities**" and is equivalent to the WCA 2010 concept of an agricultural holder."*

Canada produces all the usual types of agricultural census output, but also presents tables based on linked population/agricultural census data. The linking is done for the 20 percent of households reporting detailed data in the population census. The main population census data used in the agricultural census tabulations are:

- *Marital status*
- *Household income*
- *Country of birth*
- *Level of schooling*
- *Occupation*
- *Religion*

http://www.statcan.gc.ca

Technical issues to be considered include how to elicit the relationship between households and farm operators. Agricultural holdings in the non-household sector also require enumerating and a suitable methodology would need to be developed which would be compatible with the data collected under the population and housing census.

4.2 Assessment of country practices and suitability of the population and housing census for collecting agricultural data

This section assesses the country practices from the examples cited in section 4.1, with reference to the burden on the population and housing census and the suitability of the agricultural data collected for end users. It examines the definitions and concepts of the items collected, and recommends how data items should be defined and included in the questionnaire.

The variety of agricultural data collected in population and housing censuses reflects differing national circumstances and data needs. Most of the data collected is at a suitable level of detail for a linked population and housing/agricultural census. Countries generally include just a few agricultural items, balancing the need to gather agricultural data with keeping the population and housing census questionnaire to a manageable size. Few countries collect detailed farm labour data, which is more suited to in-depth sample surveys than to a population and housing census.

A common topic in all countries is the identification of farm households. This is the most fundamental agricultural item to be included in a population and housing census as this is the unit that corresponds to and allows for linkage with the basic statistical unit for agricultural censuses and surveys, the agricultural holding.

Not all countries use the WCA 2010 standard concept of an agricultural holding, defined as a unit operating land and raising livestock, regardless of ownership of the land or livestock. Where farm households are identified by asking about *owning* or *possessing* agricultural land or livestock, some agricultural operations may be excluded.

WCA 2010 defines two types of agricultural holding: holdings in the household sector, in which agricultural activities are undertaken and managed by household members; and holdings in the non-household sector, such as corporations and government institutions. In the majority of countries, most agricultural production is in the household sector.

The concept of the agricultural holding in the household sector is closely related to the concept of household, as explained below (FAO, 2005).

For the household sector, there is usually a one-to-one correspondence between an agricultural holding and a household with own-account agricultural production activities[2]; and these own-account agricultural activities by members of a given household usually undertaken under single management. Therefore, in many countries, the agricultural holding is defined to be equivalent to a household with own account agricultural production. This approach is considered to have several benefits, including simplification of the identification of the holding, facilitating the linkage with population and housing census, and analysis of household characteristics (FAO, 2005). Questions in the population and housing census to identify own-account agricultural activities by household members provide a good basis for identification *of* farm households and the corresponding agricultural holdings in the household sector.

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2   Households where one or more members work only as paid labourers in other holdings are not classified as farm households.

Agriculture, forestry and aquaculture are in different industry divisions under the System of National Accounts, and conceptually are considered as separate activities (FAO, 2005, p. 137).

In the WCA 2010, the scope of an agricultural census is defined with reference to the International Standard Industrial Classification of Economic Activities (ISIC-Rev 3.1). This classification system divides agricultural production into three categories: Group 011, referring to the cultivation of crops, market gardening, and horticulture; Group 012, relating to the farming of animals; and Group 013, encompassing mixed crop and livestock production (mixed farming).

Central Product Classification (CPC) provides an additional international standard. Its most recent revision, CPC 2.0, contains a number of important amendments and refinements in the area of agriculture, forestry, fisheries, and food. ISIC and CPC provide specialist instruments for integrating agricultural statistics into national statistical systems.

Meanwhile, the scope of agricultural statistics adopted by the *Global Strategy to Improve Agricultural and Rural Statistics* is based on a broader conceptual framework that includes aspects of forestry, fisheries, and land and water use. This expanded purview addresses the emerging and often closely related economic, social, and environmental issues faced by policy-makers. For the Global Strategy, agricultural statistics include aspects of forestry, fisheries, and land and water use. Items of agricultural data to be considered for inclusion in the population and housing census should therefore collect data items referring to this broader definition of agriculture, which includes crops and livestock, and also fisheries, forestry, land and water.

Identifying agricultural holders is especially useful in the population and housing census. Where agricultural holders are identified, countries should ensure that this information is linked to the personal questions on the main population and housing census questionnaire so that the agricultural holder's personal characteristics, such as sex and age, can be analysed.

The concepts of agricultural land, arable land and cropland need to be carefully considered in designing questions related to crop area in the population and housing census. Under FAO's classification of land use (FAO, 2005, p. 76), arable land is land under temporary crops, temporary meadows or temporarily fallow. Cropland is arable land plus land under permanent crops. Agricultural land is cropland plus permanent meadows/pastures. Forest land is excluded from the narrow definition of agriculture and therefore does not come under agricultural land. Suitable terminology must be developed for the questionnaire. Another issue is multiple use of land: the FAO classification is based on main use, and crops can be grown on land determined to be non-agricultural. Therefore, it is important to clarify what concept of crop area will be obtained when asking the question related to area in the population and housing census. In most cases, crop area refers to the concept of cropland.

The reporting of crop data, especially the terms growing or planting, needs careful consideration. Normally in agricultural statistics, temporary crops are reported in terms of *area planted* or *area harvested* during a particular reference period – often the agricultural year. FAO's guidelines for agricultural censuses recommend the use of area harvested. Permanent crop data tend to relate to the crops at a particular point in time, usually the day of enumeration.

There are also differences in how countries treat agricultural production. Conceptually, agricultural production covers all production, regardless of its end use, but in some countries, agricultural production for own consumption is not included in the definition. Countries should ensure that all agricultural production activities are covered.

The reference period for the collection of livestock data may also need clarification. Most countries asked a general question about livestock raised, without stipulating a reference period. Livestock data should always be reported in respect of a single point of time, usually the day of enumeration. It is not meaningful to talk about livestock numbers for an extended reference period such as a year.

The collection of farm machinery data in the population and housing census is an example of how simple modifications can be made to existing population and housing census topics to provide data of interest to agriculture. Many countries already collect data on the ownership of certain household assets, such as television, radio and motorcycle. Ownership of agricultural machinery could easily be included in this section, although it is not the practice recommended in the WCA 2010 guidelines. These guidelines recommend collecting data about machinery *used* on the holding, rather than machinery *owned* by the holding, but it would be difficult to collect data on use of machinery in the population and housing census and this is not recommended. The ownership data is still useful, but it should be noted that it is not the best practice for measuring agricultural inputs.

Specific questions about male and female agricultural activities, for the purposes of gender analysis, is considered appropriate to an agricultural census or preferably an in-depth agricultural survey, but not to the housing and population census. Measuring women's role in agriculture is difficult because of the interactions between different household members in managing agricultural activities, and the division of agricultural work within households. However, the inclusion of control questions may help to measure women's agricultural role, as illustrated by the 2007 Population and Household Census of Swaziland. After asking whether the person worked at least one hour during the past seven days and, if not, why he/she did not work, the following question was asked to those economically inactive:

Did [NAME] do one of the following activities during the last seven days? The alternatives were:

1. *farming/rearing animals/fishing;*
2. *production/services/selling;*
3. *homeworker at someone's home;*
4. *homeworker at own house;*
5. *none.*

If the reply was (1), (2) or (3) the person was classed as economically active. This type of question may not completely solve the problem of measuring female labour force participation in agriculture, but it could substantially improve its measurement and analysis.

Chapter 5

GUIDELINES FOR COORDINATING AND LINKING THE TWO CENSUSES

As each country's circumstances are different, it is not possible to provide specific recommendations about how to coordinate the population and housing, and agricultural censuses. In each country, the approach taken will depend on factors such as the availability of agricultural data, agricultural data needs, sample frame requirements, timing of the population and housing census and of the agricultural census, data collection methods for the two censuses, availability of resources, organizational arrangements for the censuses, and the existing coordination mechanisms.

The general guidelines to be found in this section are based on aspects of coordination discussed in the WCA 2010 programme and the assessment of country practices presented in Chapter 4. The guidelines address some general coordination issues in developing population and housing census - and agricultural census - programmes, recommendations about linking data between the two censuses, collecting agricultural data in the population and housing census, and using the agricultural data collected during a population and housing census to:

- Build an effective sampling frame;
- Provide auxiliary variables for optimizing survey design (where the agricultural census is conducted on a sample basis); and
- Provide core structural data about agriculture when a full agricultural module is included in the population and housing census.

Key to the collection of agricultural data in the population and housing census is a flexible approach based on a minimum set of core items for identification of farm households and a more detailed agricultural module where this is relevant and feasible.

Standard core and supplementary agricultural questions that may be considered for a population and housing census are contained in the annexes, with accompanying instructions and possible tabulations. Additional best practice from around the world is also provided.

5.1 General coordination issues in developing population and housing, and agricultural censuses

It is recommended that planning for the population and housing census and the agricultural census, is carried out within the national statistical system framework, and that questions are address overall data needs and integrate various statistical activities. This planning helps to clarify the data to be collected in the two censuses and their relationship to the overall statistical programme, especially the programme of agricultural surveys.

Agricultural specialists or the agricultural census team should be actively involved in planning the population and housing census, ensuring that requirements for agricultural data are considered at the design phase and encouraging better coordination between the two census activities. For this collaboration to be effective, the parties involved must be open to exploring all avenues for coordination.

Countries should pay close attention to the use of common statistical standards in the agricultural census and the population and housing census, to ensure that data are comparable and compliant with international standards. Well-established international standard concepts, definitions and classifications exist for most population and housing, and agricultural census items.

Countries are advised to share field materials, where possible, in developing field systems for the population and housing census and the agricultural census. The two census enumerations can generally be based on the same EAs, using the same maps, and so on, and planning ahead to ensure that field materials are readily accessible by both parties.

Coordinating the fieldwork for both censuses can be carried out in various ways:

1. Performing the whole enumeration for both censuses as a single field operation;
2. Enumerating the core agricultural census module (or selected key data items) at the same time as the population and housing census; or
3. Combining the pre-census listing operations.

5.2 Linking data from the population and housing census with the agricultural census

Coordinating the population and housing census with the agricultural census enables data from the two censuses to be linked. Population and housing census data can then be included in agricultural census tables, and vice versa. Being able to link data in this way greatly enhances its value. Statistical matching, which links similar rather than identical units and is used where the censuses have few or no common records, is not recommended. Various methods of linkage are available depending on the strength of association between data sets: exact matching where there is complete agreement between key variables which uniquely identify the households; judgemental matching where key variables are not exactly identical but can be matched using human or computer examination; and probability matching which matches records based on the agreement of a set of key variables such as age, date of birth and name.

Population and housing census data are usually linked with agricultural census data by assigning the same identifier to each household in both censuses. This is possible where the agricultural census is based on a list frame from the population and housing census. Linking data is most straightforward when the two census field operations are carried out together, as in the Canada 2001 censuses, or when the two censuses are linked through an agricultural module in the population and housing census, as in the Burkina Faso 2006 census.

Either of the above approaches enables exact matching of households from the population and housing census with the agricultural census. Data for each household can then be merged so that, for instance, the number of adult household members from the population and housing census can be tabulated with farm area from the agricultural census. The same can be done for persons; for example, the agricultural holder is assigned the person number given to the same individual in the population and housing census, enabling the personal characteristics of the agricultural holder (collected in the population and housing census) to be tabulated. The ability to link data in this way allows, for example, the educational level of the head of the household's wife (from the population and housing and

household census) to be tabulated alongside farm area (from the agricultural census) .

Even so, various issues can arise owing to differences in the statistical units or other concepts used in the two censuses. When households in the population and housing census are matched with farm households in the agricultural census, a one to one match is possible and there is little problem. However, difficulties can arise when the concept of the holding is introduced. In most cases there will be a one-to-one correspondence between holding and household but special procedures are needed where a holding is managed by multiple households (see the case study for Burkina Faso).

Where there is a time gap between the two censuses, it will not be possible to match all households even if the same frame is used. For example, new households can be formed, while others can disappear owing to divorce, death, migration and so on. Reporting errors and non-response in either census can also prevent matching, with weaknesses in the questionnaires or data processing systems making it difficult to determine the identifiers necessary for matching the data.

Other linking methods are available for datasets that are not closely integrated. These allow for exact matching by creating a unique identifier based on a combination of variables such as names, dates of birth, gender, address and postcode. Errors can still occur owing to variations in spellings, errors in data coding and preparation, use of initials, abbreviation of names and addresses, use of compound names, missing words, extra words, and the like. For instance, John Chan and J. A. Chan could be the same person - a particular problem where addresses are not standardized and zip/post codes are not used.

Where unique identifiers are not available, it is possible to link datasets using probabilistic record linkage. Partial matches are assessed for the probability that there is agreement when correctly linked compared to the probability that there is agreement by chance in an incorrectly linked match. The use of variables that divide the population into many subclasses have a greater chance of correctly identifying matches. Reporting errors, missing data and household changes complicate this matching. Statistical procedures have been developed to deal with problems such as non-unique matches (where for instance two people fit one particular description).

Linking of datasets is receiving attention in statistical offices around the world and undoubtedly holds considerable potential for countries in the future.

BOX 3 – BURKINA FASO

Mapping holdings in the agriculture census to households in the population and housing census

In the General Census of Agriculture (GCA), the definition of agricultural household adopted was: *"any household which declared during the General Population and Housing Census (GPHC) 2006 as having engaged in at least one of the following activities: temporary crops (rain-fed crops, horticulture), livestock or arboriculture".*

For the GPHC, the demographic household was defined as: *"a unit consisting of a couple with their unmarried children living in the same home".*

During field collection the questionnaire was filled for each demographic household. However, an agricultural holding can be operated by several demographic households, if they operate agricultural parcels jointly.

In the questionnaire, every demographic household forming part of the agricultural holding was given a code subsidiary to that of the demographic household which was coordinating the agricultural activity of that holding. Demographic households were grouped to form one "agricultural household" using this subsidiary code. The head of the demographic household that coordinates the agricultural activities of the group is considered to be the head of the "agricultural household".

5.3 Collecting agricultural data in the population and housing census

5.3.1 Issues arising from collecting agricultural data through the population and housing census

As discussed in Chapter 4, collecting agricultural data during the population and housing census works in countries where the agricultural census is carried out as a household enquiry and most agricultural production comes from household-based agricultural holdings. When considering additional agricultural data items to be included in a population and housing census, it is worth remembering that the population and housing census may not be suited for collecting complex agricultural data.

Given the variety of contexts from one country to the next, a flexible approach is proposed. This proposes a limited set of core items and more detailed set of items where feasible. The purpose of core data items and questions suggested for inclusion in the population and housing census is primarily to identify farm households and their corresponding agricultural holdings. In countries where agricultural production is mainly household based, the population and housing census offers a unique opportunity to identify holdings and to build a cost-effective frame for the agricultural census or, where the agricultural census is conducted on a sample basis, to design an efficient survey.

For some countries, it will be worth considering additional data items and questions about the structure of agriculture. Mozambique (limited questions) and Burkina Faso (larger agricultural module) have successfully included an agricultural module in their population and housing census, which has resulted in very effective agricultural censuses. Canada has a long tradition of joint population and housing, and agricultural censuses. These guidelines suggest additional potential data items and questions, depending on a country's context and the use that can be made of the data.

Collecting data about agricultural production in the population and housing census, or even in the agricultural census, is not recommended. The purpose of the agricultural census is to provide information about the structure of agriculture. Production is best estimated through a special survey, focusing on specific crops.

As mentioned in Chapter 4, the use of the population and housing census to obtain information basic information about agriculture and rural households is one way to provide a broader scope which would cover the conceptual framework used in the Global Strategy - where the word agriculture includes forestry, fishery and aquaculture, land and water use.

When considering the inclusion of agricultural items, one of the main issues to consider is that the population and housing census is usually the largest statistical operation carried out in a country and care is needed not to overburden it with too many or too complex questions. Many thousands of enumerators may be needed to enumerate every household in the country, and questionnaires and field procedures must be kept simple. In most countries, only a limited number of questions can be included. Detailed data are better collected in sample surveys, where more in-depth questioning can be used.

In specific circumstances, data on a wider range of topics may be collected during a population and housing census. This is for example the case in some small island countries where substantial cost savings can be made by collecting the core structural data for agriculture during the population and housing census. To collect agricultural data beyond those basic questions in the population and housing census, an optional agricultural module in the population and housing census can be considered. Recent experiences in a number of countries have shown that 60 to 80 percent of the data items proposed by FAO for the core module of the agricultural census in WCA 2010 can be collected in this way. The remaining structural and in-depth data can then be collected through a series of sample-based supplementary modules in the agricultural census.

It is important to decide how to apply the concept of the agricultural holding, since this is the primary statistical unit for the agricultural census whereas for the population and housing census it is the household. The relationship between the concepts of household, farm household and agricultural holding should be made clear.

According to the UN guidelines for population and housing censuses, "The concept of household is based on the arrangements made by persons, individually or in groups, for providing themselves with food or other essentials for living. A household may be either (a) a one-person household, that is to say, a person who makes provision for his or her own food or other essentials for living without combining with any other person to form part of a multi-person household, or (b) a multi-person household, that is to say, a group of two or more persons living together who make common provision for food or other essentials for living. The persons in the group may pool their incomes and may, to a greater or lesser extent, have a common budget; they may be related or unrelated persons or constitute a combination of persons both related and unrelated" (UN, 2008, p. 102).

A farm household is where one or more of the household members are engaged in agricultural production. What is of importance is the household, rather than the dwelling unit. On one hand there may be more than one household in a single dwelling. On the other hand one household may also consist of extended families[3] making common provision for food and occupying more than one dwelling. In other cases, different family units live in separate dwellings but have a common head, as in polygamous unions.

An agricultural holding is defined as "an economic unit of agricultural production under single management comprising all livestock kept and all land used wholly or partly for agricultural production purposes, without regard to title, legal form, or size" (FAO, 2005, p. 21).

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3   The concept of family is different from *household* since a family may include people living in more than one household in separate places.

BOX 4 – CANADA
Case study linking population and agriculture census

For the censuses between 1975 and 2006, a unique identifier was assigned to the population census and agricultural census by the enumerator when the questionnaire was dropped off. The identifier was written manually onto questionnaires and included province, electoral district, enumeration area and household number.

Automated matching was carried out by computer, using this identifier. One main reason for non-matching has been enumerator error in recording the key geographic codes - especially where the location of the census farm and the location of the farm-operator household were different in which case the enumerator of the agricultural questionnaire and the population questionnaire would be different people. Other errors in matching occur where there are mistakes in the information about operators, which can result for example in the same operator on two different holdings being matched to two different people in the population census.

For non-matched records, manual intervention was used. In these cases, the household number of the population census was assigned to the agriculture census questionnaire.

The farm operator was then identified from household members using coding from the population questionnaire together with answers to specific questions.

The matching process produced a matched record pair for each census-farm, which was the base unit. This contained the identification criteria for the household and the operator. These linked records were used to produce index files/look-up files, which could then be used to link the population and agricultural data.

Bollman 2009

The following additional points relate to the identification of an agricultural holding:

- Agricultural holdings may have no significant land area; for example, poultry hatcheries or holdings keeping livestock for which land is not an indispensable input for production.

- Agricultural holdings may be operated by persons who do not have any rights to agricultural use of the land except for the products of the trees grown on it (tree holdings).

- If a member of a cooperative, religious organization, government agency, clan or tribe is assigned a separate unit for agricultural production that is operated under the member's management, and over which the member has general, technical and economic responsibility, then this unit represents a holding.

- Open rangeland (such as land open to communal grazing) is not normally considered a holding. A specified area delimited by fencing, or any other form of boundary demarcation may be an exception.

The correspondence between agricultural holding and household is detailed in WCA 2010, paragraphs 3.27 to 3.35. The following text is an extract from these paragraphs. "For the agricultural sector, there is usually a one-to-one correspondence between an agricultural holding and a household with own account agricultural production; all own account agricultural production by members of a given household are usually undertaken under single management since managing agricultural production usually goes hand-in-hand with making common arrangements for food and other essentials, pooling incomes, and having a common budget. It is unusual for different household members to operate agricultural land or livestock completely independently and yet pool incomes. It is also unusual for household members to operate land or livestock as a single unit while maintaining independent household budgets. Even if there is a degree of independence in the agricultural activities of individual household members, the income or produce generated by the various members is usually pooled. Often, different members of the same household own land but the household's agricultural operations are usually carried out as a single unit" (FAO, 2005, p. 21).

A holding is defined by its activities and management arrangements, and a household therefore relates to the holding in terms of the agricultural activities that the individuals within the household manage. The management unit is the holder or joint holder and is defined as the person who makes the major decisions regarding use of resources and who has management control over the agricultural holding.

The first step is to ask what *activities* the household is conducting. To be a holding it must be carrying out "own account" agricultural production - that is activities managed by the household. A household that contains individuals working as labourers for another household does not qualify as a holding, neither do non-agricultural activities qualify as a holding.

The second step is to understand how these agricultural activities are being *managed*, as the management arrangement determines the type and number of holdings. The relationship between the household and the number of holdings is determined by the management units within the household. A management unit consists of the individuals who make the management decisions over particular activities. Note that to qualify as a separate holding, the household (or individuals within the household) must be managing the activities. Owning agricultural land that is managed by another household does not qualify.

Usually there is a one-to-one correspondence between the household and the holding. When there is only one management unit for particular agricultural activities, there is one holding. The management unit is normally made up of individual(s) from one household.

There are exceptions, for instance where there is more than one household associated with a holding, as when the holding's management unit is made up of individuals from more than one household. WCA 2010 states that, "A household may operate land or keep livestock jointly with another household or group of households. There is one holding made of the joint agricultural operations with the other household(s). The household may also have its separate agricultural production, which will be another holding. Example of two married brothers who operate jointly the family land but have separate arrangements for food" (FAO, 2005, p. 22).

Another exception is when there is more than one holding associated with a household, which occurs when there is more than one management unit for the household's agricultural activities. Having more than one management unit means that different individuals in the household manage separate agricultural activities. WCA 2010 states that, "If there are two or more units making up a household, such as where a married couple lives in the same dwelling as their parents, the two units may operate land independently but, as members of the same household, they make common arrangements for food and pool incomes" (FAO, 2005, p. 21).

The following examples will illustrate these concepts using scenarios that show different arrangements for managing agricultural activities. Household A is comprised of a couple, their son and his wife, and their two children. Household B is comprised of the couple's younger son and his wife; they do not reside with the parents but live in another village and cook for themselves.

FIGURE 2
Household roster

	HOUSEHOLD ROSTER - HOUSEHOLD A
Householder Number	**Relationship to the head of the household**
01	01: Head of household A
02	02: Wife A
03	03: Son
04	04: Daughter-in-law
05	10: Grandchild
06	10: Grandchild
	HOUSEHOLD ROSTER - HOUSEHOLD B
Householder Number	**Relationship to the head of the household**
01	01: Head of household B
02	02: Wife B

Code Section AR		
01: Head of household	07: Father/mother-in-law	13: Nephew/niece
02: Husband/wife	08: Siblings	14: Cousin
03: Adult son/daughter	09: Brother/sister-in-law	15: Servant
04: Son/daughter-in-law	10: Grandchild	16: Other relative
05: Child	11: Grandparent	17: Non relative
06: Parents	12: Uncle/aunt	

FIGURE 3

Activities of households
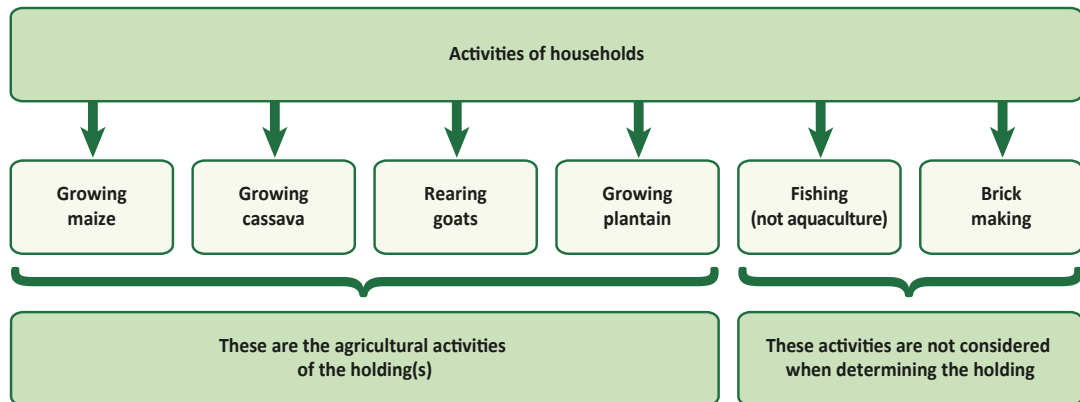
Scenario 1 - One household managing one holding

Household A grows cassava and maize, and keeps a few goats. These activities define it as a farm household. The head of household makes the major decisions about crop and livestock management (the maize, cassava and goats). The wife, son and daughter-in-law work on the farm.

In this scenario there is only one holding as there is a single management unit, from one household, for all agricultural activities.

FIGURE 4

Scenario 1 - One household managing one holding
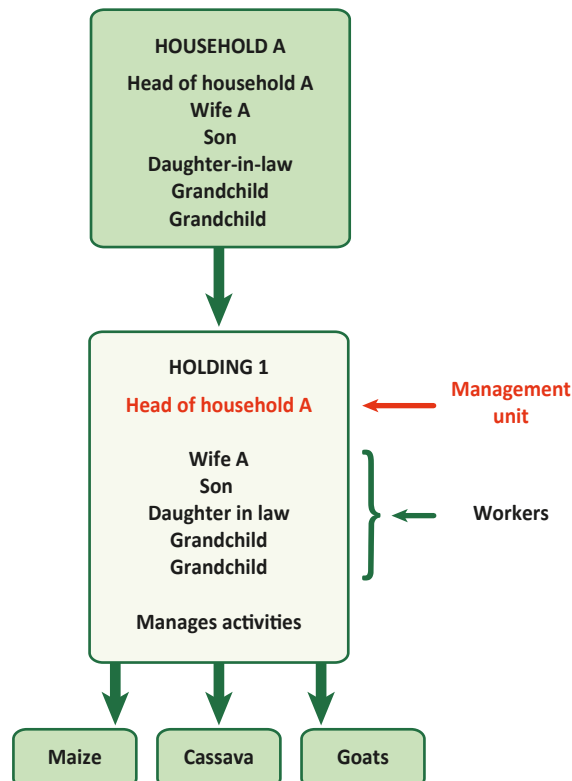
This is the case of the majority of households in rural areas in most developing countries: one household =>one farm household =>one holding. The identification of the farm household and corresponding holding will not raise particular difficulties during the population and housing census.

It should be noted that engaging in aquaculture is considered an agricultural activity whereas engaging in fishing is not. For instance, if the son managed the fishery activities, rather than the head of household doing so, this household would still operate only one holding.

Scenarios two and three illustrate special cases where there is not a one-to-one match between the household and the agricultural holding:

Scenario 2 - One household managing more than one holding

In this scenario, the head of household A and his wife grow maize, with the head of household making the management decisions. The second family unit in the household (son, daughter-in-law and grandchildren) grows cassava and keeps goats. The son makes the management decisions, and his wife and children carry out the work in the fields and take care of the goats.

Here there are two holdings, as there is independent management of the two groups of agricultural activities. In this case, the son manages the activity of growing cassava and rearing goats; and the head of the household manages the activity of growing maize. These are the two management units. Note that the activities are the same as under Scenario 1 but there are two holdings because the activities are managed separately by two management units, even though they come from the same household. The other family members work on separate holdings but this is irrelevant to the definition of the holding as they do not manage the activities.

FIGURE 5

Scenario 2 - One household managing more than one holding
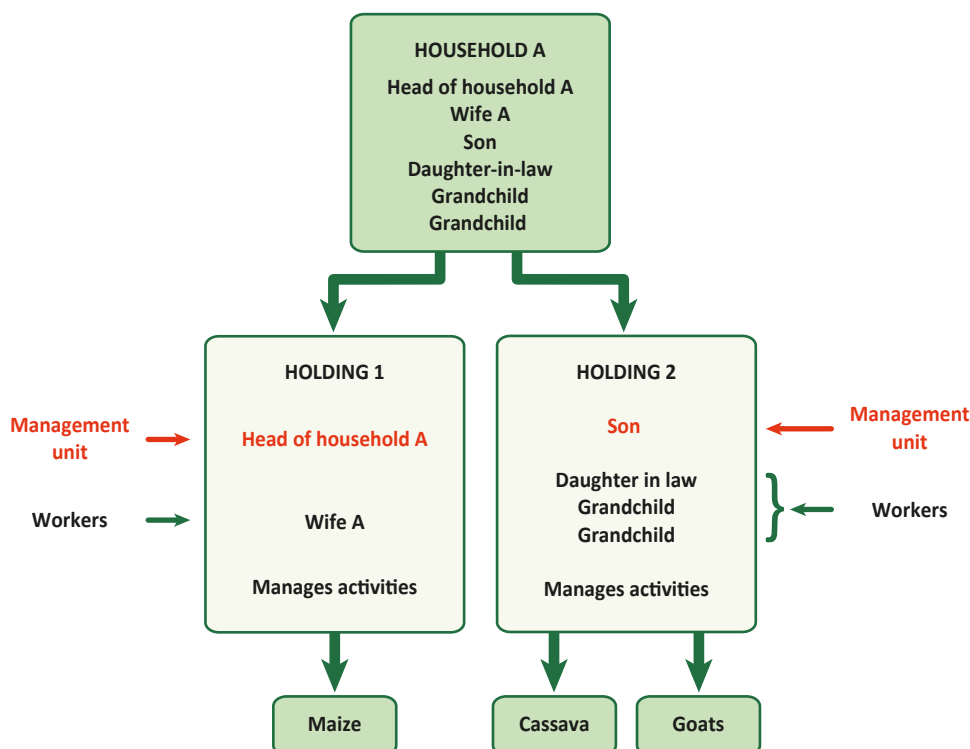
In this scenario, Household A can be identified as a farm household during the population and housing census. In those countries where no further questions are asked about the management of agricultural activities, the opportunity to identify the two separate holdings within that farm household will be missed. These questions can be asked during the listing operation of primary sampling units, where the agricultural census is conducted using two stage sampling.

Scenario 3 - More than one household managing one holding

In Scenario 3, Household A grows maize, cassava and keeps goats, with the head of Household A making the decisions. The rest of the family works on the farm. They also grow plantains together with their younger son who lives in another village with his wife (Household B). The younger son (Household B) and the head of Household A together make decisions on the best way to manage the plantains. The younger son's wife does most of the work in the plantain field but the other members of Household A also help out.

In this scenario there is one holding (Holding 1), as the two households jointly manage the agricultural activity of growing plantains. In this case, the heads of households A and B both manage the plantain crop - a joint production activity with a joint holding. There is **one** holding rather than two because there is a single management unit for the growing of the plantains, even though it has two households contributing.

FIGURE 6

Scenario 3 – More than one household managing one holding
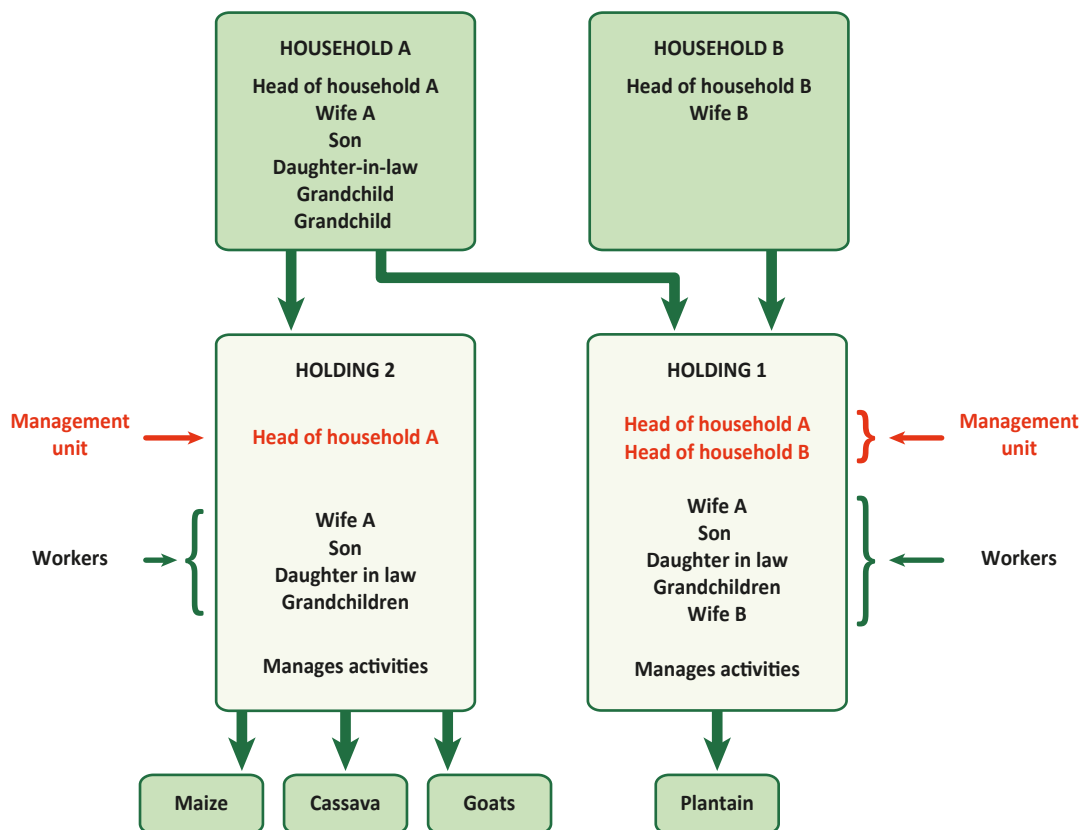
Household A undertakes the additional agricultural activity of growing maize, cassava and keeping goats - managed in this case by the head of Household A alone, without the help of Household B's head - and this is classed as a separate holding (Holding 2). The first holding was under joint management but the second is a separate management unit as it is Household A alone. The members of Household A's family work on both holdings but, again, this is irrelevant to the definition of the holding as they do not have management responsibility.

In this scenario, two farm households will be identified during the population and housing census. The example provides for two holdings, but it might have been just one holding had B not also been engaged in an independent agricultural activity (growing plantain).

In conclusion, what is easily identified during the population and housing census is the farm household. In general, one farm household corresponds to one holding but this is sometimes not the case. The identification of specific holdings within the farm household requires more detailed questions that it is not always possible to ask during the population and housing census.

Appendix 1 of WCA 2010 provides a detailed explanation of what is meant by a holding, within the System of National Accounts (SNA) framework, and how it corresponds to the two key concepts of enterprise and establishment.

An enterprise is an economic unit of production under single management. It can engage in more than one type of activity. In contrast, an establishment engages in a single type of production activity. If it engages in other activities, these are only on a small scale.

In the household sector, an enterprise - as the economic unit for agricultural production under single management - usually corresponds with the household. An establishment – as a single type of agricultural activity - usually corresponds with the holding, as the holding is defined by agricultural activities. The activities of the establishment or holding are carried out on behalf of the household enterprise.

In scenario 1, there is one enterprise (the household) and one establishment (the holding).

In scenario 2, there are two management units overseeing the activities of the two families in the household. The definition of an enterprise as activities under single management means that we can distinguish two enterprises here. Each enterprise contains one establishment (the holding). In this case, one household contains two enterprises and two establishments.

In scenario 3, there are again two households and two enterprises. The first enterprise jointly manages the growing of tomatoes and the second enterprise manages the activities undertaken by Household A. Each enterprise has one holding. However, if the only activity were the joint tomato growing, then there would be two households with one enterprise.

These scenarios illustrate that the relationship between the household(s) and the enterprise depends on the management units of the household(s). A single management unit corresponds to the enterprise. The agricultural activities of the management unit correspond to the holding and the establishment.

5.3.2   Data collection methods

As discussed above, collecting agricultural data through the population and housing census can be restricted to limited items or may include a more comprehensive agricultural module.

The main population and housing census could include the core agricultural items A1 - whether the household is engaged in any form of own-account agricultural production, and A2 – the area of land

(or number of plots) used for agricultural purposes. These items would be used to identify whether the household is a farm household and to measure farm size.

The supplementary items recommended by WCA 2010 are best collected as an agricultural census module based on a sample of farm households.

Some countries use the short and long forms of their population and housing census to collect different items, with the short form used to collect a few basic items from all households and the long form used to collect detailed data, including the agricultural module, from either all farm households identified or a sample of these.

5.3.3 Agricultural data items and suggested standard questions for a population and housing census

There is no general recommendation to include an agricultural module in the population and housing census, but this section shows how to design such a module should a country decide on the need to collect additional agricultural data. The general guidelines for coordinating population and housing, and agricultural, censuses also apply. Annex 1 outlines core and supplementary agricultural module questions for the population and housing census, with corresponding instructions.

Data items

Minimum core data items proposed. The minimum agricultural module for including in the population and housing census, at the household level, has to provide information with which to construct an effective and up-to-date frame for agricultural censuses and surveys, as follows:

- Item A1. Whether the household is engaged in any form of own-account agricultural production (including livestock, fishery, aquaculture or forestry).
- Item A2. The area of land (or number of plots) used for agricultural purposes.

Item A1 identifies whether the household is a farm household and Item A2 provides a measure of farm size.

These are key variables for:

- constructing a list, or area frame, of farm households when conducting an agricultural census shortly after the population and housing census.
- providing data for population and housing census tabulations to analyse the relationship between population and housing census characteristics and agricultural activities.

Supplementary data items. An additional ten supplementary items may be included in the agricultural module of a population and housing census (based on WCA 2010 core items).

Items to consider in the population and housing census supplementary agricultural module are listed below. A country would tend to select from the listed items according to their requirements, rather than including everything on the list. The supplementary module could be anything from a few questions to a small-scale agricultural census.

The population and housing census supplementary agricultural module should roughly correspond to FAO's core agricultural census items, apart from the two population and housing census core items. Countries may need this supplementary agricultural module to provide more detailed data if agricultural census data are unavailable or incomplete.

TABLE 1

Mapping of suggested supplementary items to WCA 2010 agricultural census core data items

Data items for a SUPPLEMENTARY agricultural module in the Population and Housing Census	Corresponding AGRICULTURAL CENSUS CORE DATA item
Item S-A1: Identification of *agricultural holders*	
Item S-A2: Main purpose of production	0006 Main purpose of production from the holding Number of land parcels
Item S-A3: Area of agricultural land according to land use types	0007 Area of holding according to land use types 0008 Total area of holding, where possible (minimum question)
Item S-A4: Land tenure types	0009 Land tenure types on the holding
Item S-A5: Presence of irrigation	0010 Presence of irrigation on the holding
Item S-A6: Types of temporary crops grown	0011 Types of temporary crops on the holding
Item S-A7: Types of permanent crops grown and whether in compact plantations	0012 Types of permanent crops on the holding and whether in compact plantations
Item S-A8: Number of animals for each livestock type	0013 Number of animals on the holding for each livestock type
Item S-A9: Presence of aquaculture	0014 Presence of aquaculture on the holding
Item S-A10: Presence of forest and other wooded land	0015 Presence of forest and other wooded land on the holding

The following demographic data items recommended by WCA 2010 for inclusion in the core agricultural census module are also covered in all population and housing censuses:

0003 Sex of agricultural holder.

0004 Age of agricultural holder. Sex of household members. Age of household members.

0005 Household size.

Data items in the agricultural census core module not covered by the recommended data items:

0001 Identification and location of agricultural holding (minimum question).

0002 Legal status of agricultural holder.

0016 Other economic activities of the holding's enterprise.

The ten supplementary data items (in the left hand column above), added to the three demographic items collected in all population and housing censuses, together provide data on 13 of the agricultural census core module items (over 80 percent), which moreover would be available on the basis of complete enumeration.

These 13 items still differ, to some extent, from the agricultural census core items because of the enumeration units used - agricultural holdings in the agricultural census, and farm households in the agricultural module of the population and housing census.

The main differences are:

- FAO Item 0001 identifies the agricultural holding. This is not recommended for the population and housing census. Identifying the farm household is included in the population and housing census core module.

- FAO Item 0002 legal status of holder is excluded because of the different statistical units involved.

BOX 5 – MOZAMBIQUE
Agricultural questions in 2007 Population and Housing Census

Mozambique conducted its Population and Housing Census in 2007. It included an agricultural module (Section G) in the population census household questionnaire. The questions were as follows:

G 1: Does any member of the household practice agriculture for himself?

Yes ☐*1*   *No* ☐*2*

G2: Does the household have any tank for aquaculture?

Yes ☐*1*   *No* ☐*2*

If yes, how many?   ....

G3: Does any member of the household practice fishing through traditional methods?

Yes ☐*1*   *No* ☐*2*

G4: Does this household have cashew trees?

Yes ☐*1*   *No* ☐*2*

If yes, how many?   ....

G5: Does this household have coconut trees?

Yes ☐*1*   *No* ☐*2*

If yes, how many?   ....

G6: How many animals does this household have?

G 6.1	*Cows/Bullocks*	....
G 6.2	*Goats*	....
G 6.3	*Sheep*	....
G 6.4	*Pigs*	....
G 6.5	*Chicken*	....
G 6.6	*Ducks*	....

The data collected was used to build an effective sampling frame for the (sample based) agricultural census conducted in 2010.

Along with the demographic part of the population census, these questions cover 7 of the 16 items of the agricultural census module, namely:

1. *Identifying and locating the agricultural holding (0001).*
2. *Sex of agricultural holder (0003).*
3. *Age of agricultural holder. Sex of household members. Age of household members (0004).*
4. *Household size (0005).*
5. *Types of permanent crops on the holding [COCONUTS AND CASHEWNUT TREES] (0012).*
6. *Number of animals on the holding for each livestock type (0013).*
7. *Presence of aquaculture on the holding (0014).*

- FAO Items 0003 and 0004 sex and age can be identified from supplementary item S-A1 which identifies the agricultural holders in the farm household. Once identified, any personal data from the population and housing census can be derived, as well as other items such as educational attainment.

- FAO Items 0007 and 0008 farm area data in the FAO core agricultural census module uses the term area of holding. This is not directly applicable in the population and housing census agricultural module because holdings are not defined. For the population and housing census core agricultural module, farm size is referred to in terms of area of land used for agricultural purposes. This is slightly different from area of agricultural land as defined by FAO and used in the population and housing census supplementary agricultural module.

- FAO Items 0014 and 0015 about the presence of fishery, aquaculture and forestry can be extended in a population and housing census to all households, in the wider sense of agriculture adopted in the conceptual framework of the Global Strategy.

- FAO Item 0016, on other economic production, is omitted.

Model questions for identifying farm households in the population and housing census

Different approaches are used from one country to the next in gathering agricultural data through the population and housing census. Of necessity, the questions needed to elicit a particular item vary from country to country, depending on agricultural practices, language, farmers' understanding of farming issues, enumeration methods, quality of enumerators and local sensitivities.

To identify farm households, for example, it may be appropriate in Canada to ask whether there is a farm operator in the household but this may not work in other countries. The question may instead need to specify the household's crop and livestock production, as in Cyprus, Fiji, Uganda and Zambia. Alternatively, a series of questions on crop and livestock activities may be needed, as in Botswana, Cook Islands, Nepal, Seychelles and Sierra Leone. The important thing is that countries use standard data items, not standard questions. Each country will develop and test its own most effective ways of asking questions to elicit the data items required. Alternative ways of asking questions to identify farm households are discussed below.

A country could ask a simple question along the lines of:

Q1: Is anyone in the household a farm operator?

    Yes ❏*1*   *No* ❏*2*

Respondents would need a clear understanding of what the term "farm" includes and what being an "operator" means. In general, this question by itself would not provide satisfactory data. It could be expanded to specifically mention crop and livestock production, as in:

Q1: Does anyone in the household operate a crop or livestock farm?

    Yes ❏*1*   *No* ❏*2*

Alternatively, suitable response categories could be provided as in:

Q1: Is anyone in the household a farm operator?

    Yes, grows crops   ❏

    Yes, raises livestock   ❏

    No, not a farm operator   ❏

Another method is to ask separate questions about crop and livestock, such as:

Q1a: Does anyone in the household operate a farm growing crops?

    Yes ❏*1*   *No* ❏*2*

Q1b: Does anyone in the household operate a farm raising livestock?

    Yes ❏*1*   *No* ❏*2*

Instead of asking about the crops grown, the *household* could be questioned about the *land used for agricultural production*. In this case an additional item about livestock would be needed because livestock can be raised without operating any land. The following questions could be used:

Q1a: Does anyone in the household operate any land used for agricultural purposes?

    Yes ❏*1*   *No* ❏*2*

Q1b: Does anyone in the household raise any livestock?

    Yes ❏*1*   *No* ❏*2*

It may be necessary to be specific about reference periods for growing crops and raising livestock, as in:

Q1a: Did anyone in the household operate any land used for agricultural purposes

    during the ..... agricultural year?

    Yes ❏*1*   *No* ❏*2*

Q1b: Is anyone in the household now raising any livestock?

    Yes ❏*1*   *No* ❏*2*

Sometimes, more detailed questions may be needed to prompt respondents to report all agricultural production activities. For example:

Q1a: Does anyone in the household operate a farm growing crops?

    Yes, grows rice   ❏

    Yes, grows other annual crops   ❏

    Yes, has fruit trees or other permanent crops   ❏

    No, not a crop grower   ❏

Q1b: Does anyone in the household operate a farm raising livestock?

    Yes, raises cattle or buffaloes   ❏

    Yes, raises sheep, goats or pigs   ❏

    Yes, raises poultry   ❏

    No, does not raise livestock   ❏

Often, minimum size criteria are applied in defining a *farm household* to exclude households with just a little agricultural land and/or a few livestock. Here, it would be necessary to ask specific questions about the area of agricultural land and the number of particular types of livestock. Thus:

Q1a: Does anyone in the household operate any land used for agricultural purposes?

    Yes ❏*1* → *Q1b*

    No ❏*2* → *Q1c*

Q1b: What is the total area of the land used for agricultural purposes operated by members of the household? ....
Q1c: Does anyone in the household raise any livestock? *Yes* ❑*1 → Q1d* *No* ❑*2 → Finish*
Q1d: How many of the following livestock types are being raised by members of the household? *Cattle* .... *Buffaloes* .... *etc.* ....

It may even be necessary to ask questions about agricultural production activities for each person in the household, as in:

Q1a: Does this person operate a farm growing crops? *Yes* ❑*1*   *No* ❑*2*
Q1b: Does this person operate a farm raising livestock? *Yes* ❑*1*   *No* ❑*2*

All the above question options rely on respondents understanding the concept of *farm operator*, as opposed to being an employee working on a farm. An additional question may be needed to clarify this, for example:

Q1: Is anyone in the household a farm operator? *Yes* ❑*1*   *No* ❑*2*
Q2: Does the farm operator make day-to-day management decisions for the farm? *Yes* ❑*1*   *No* ❑*2*

Depending on the country, other products such as ornamental flowers production, beehives and so on, may be included in the information elicited. Additional questions could draw out the main purpose of production (whether for own consumption or sale). These are simple questions that help to build a specific frame for different types of surveys.

The questions identifying a farm operator are quite important, and particular care should be taken to include clear instructions to the interviewer - in the questionnaire itself or in the instruction manual. During training, this issue should receive special attention. Interviewers need to be trained to explain to the respondent in simple terms the difference between a farm operator and a farm employee.

Chapter 6

USE OF AGRICULTURAL DATA FROM THE POPULATION AND HOUSING CENSUSES TO BUILD SAMPLING FRAMES FOR AGRICULTURAL CENSUSES AND SURVEYS

One major innovation of the WCA 2010 is its recommendation that a *complete enumeration* of a very small number of data items (16 items) be conducted as a core module, with *sampling* used to collect more detailed data in specific and country-relevant modules. The use of sampling is a key element in this new approach, in which the availability of an effective sampling frame becomes crucial.

This chapter focuses on the use of the agricultural data collected during the population and housing census to construct an effective sampling frame for agricultural censuses and surveys. It can provide information for a list frame and supplementary information for area frames.

For countries where households are the main agricultural producers, the population and housing census can be a very good source of information for constructing an agricultural census frame. An agricultural census conducted at the same time or soon after the population and housing census can be based on a list frame from the population and housing census. If the agricultural census is conducted sometime after the population and housing census, an area frame is more suitable (using information from the population and housing census enumeration area), supplemented by a list frame of large or specialized farms. The area frame can also be augmented by a list of enumeration areas with indications of the number of agricultural holdings, which can provide a useful input into the area frame.

One type of agricultural frame is the list frame, which is a list of all the units to be covered by the agricultural census or survey. The limited agricultural items included in the population and housing census are used to identify farm households, the unit of the frame. The ideal frame for an agricultural census is a list of all agricultural holdings but this can be difficult to obtain so the frame is usually based on the farm household unit instead.

For an agricultural survey or an agricultural census supplementary module, the ideal frame is a list of specific types of agricultural holdings or farm households, such as farm households with livestock (for a livestock module) or farm households that grow rice (for a rice production survey). Additional items required for the supplementary module would be collected during the enumeration of the agriculture census core module.

The WCA 2010 provides recommendations where it is not possible to include questions to identify farm households in the population and housing census, it is still possible to use the household frame from the population and housing census as a starting point for the list frame of the household component of the agricultural census.

A common method in this case is to:

- At the PSU level the information from the population and housing census would provide a list of EAs and the number of households in each EA.

- At the SSU stage the list of households enumerated in the population and housing census could be used as a starting point. Each household in the SSU would be asked some screening questions to identify households that fall within the scope of the agricultural census (in other words households engaged in self-employed agricultural production), and then ask all of those households some questions to identify individual agricultural holdings.

- Enumerate each agricultural holding for the agricultural census (FAO, 2005).

When constructing list frames for agricultural censuses and surveys using the population and housing census as a basis, countries should be aware that timing and operational issues are of key importance. The agricultural census frame may be required immediately after the population and housing census, and special operational or data processing arrangements may need to be made. One solution is to have a joint pre-census fieldwork phase to identify households for the population and housing census and farm households for the agricultural census.

BOX 6 – NEPAL
Examples of building frame for the agricultural census

The proposed sampling design was a multiple frame (two frames, in fact), with a list frame for the Private Large Scale and Institutional Farms (PLS&IF) and an area frame for all other household-based holdings. The list frame, which was only part of the totality of all Private Large Scale and Institutional Farms, was to be completely enumerated.

For smallholder farms, the sampling procedure designated districts as strata. In each stratum, a sample of Enumeration Areas (EAs) was then selected as primary sampling units (PSUs) in the first stage. A sample of agricultural households was subsequently selected from each sample EA as second stage units (SSUs).

Frame for PSUs (EAs)

The frame for PSUs, i.e. EAs, was based on the 2002 population and household census. This was a suitable choice for the PSU frame, but during the selection process the frame was found to have a number of inconsistencies. The EAs had not changed but the number of districts had increased from 56 to 80 during this period. It has been possible to identify the EAs concerned and to apportion the agricultural households (as in PHC 2002) to the new districts on the basis of identifying the counties, sub-counties and parishes within the new districts.

Frame for SSUs (agricultural households)

In the selected EAs, information was collected for all households through the listing module. Based on the information collected in this module, lists of agricultural holdings (large, medium and small) were prepared. Those large-scale farmers already in the independent list frame were not included twice, and the separately prepared list frame was not updated on the basis of the EA listing. Care was taken to make the frames complete at SSU level and to avoid duplication. Samples of small and medium holdings will be selected from this frame while large-scale farmers will be completely enumerated - whether they are in the list frame or in the selected EAs. The information obtained from large-scale farmers in the selected EAs is to be suitably scaled-up with the sample weights while those obtained from the list frame are to be simply aggregated. If the large-scale farmers, as observed in the sampled EAs, were to be added to the list frame, the large-scale farmers in the non-sampled EAs would not be represented and there would be underestimation. The extent of any underestimation will eventually depend on the completeness of the list frame. Households are to be selected in the field. It should be emphasized that strict supervision and quality control measures are vital at the listing stage, to avoid any duplication or omission in the frame at this stage.

Chapter 7

IMPROVING EFFICIENCY OF AGRICULTURAL CENSUS AND SURVEY DESIGN

As indicated above, *sampling* is a key element in the new approach recommended by the WCA 2010, and is used to collect detailed data for those supplementary census modules relevant to the country.

This section focuses on using the agricultural data collected during the population and housing census to construct an effective sampling frame for agricultural censuses and surveys.

In most countries, two stages stratified cluster sampling is commonly used. Primary Sampling Units (PSUs) are selected by Probability Proportional to Size (PPS), then Second Stage Sampling Units (SSUs) are often selected with equal probability within each sample PSU.

PSUs are often selected from the population and housing census Enumeration Areas (EAs). SSUs are selected from the farm households or holdings. Typically, a sample of EAs is first selected. A list of farm households or agricultural holdings is compiled for each sample EA. Finally, a sample of those households/holdings listed is selected for enumeration.

The key questions to be addressed by the survey planners are how to determine the size of the sample and how to allocate the sample between strata. Other concerns include striking a balance between PSU size and SSU size for any given total sample size: whether selecting more PSUs, with fewer SSUs in each PSU; or a smaller number of PSUs, with more SSUs per PSU.

7.1   Use of agricultural variable in survey design

As indicated in the country examples above, data collected during the population and housing census include information about the amount of land operated by the holding, number of each species of livestock, or area under specific crop of national importance, and so on.

These data can be used to inform choices about survey design, which for example, can be stratified at PSU and implicitly at the SSU stage with systematic sampling on size. Types of variable which can be used to decide the strata could be the scale of operation, or type of agricultural activities of a holding. Besides improving the reliability of livestock statistics from the sample agricultural census, this approach can contribute to planning livestock production surveys or crop yield surveys.

This approach, of analysing the variables of interest so as to decide on survey design, was recently used in Mozambique's Census of Agriculture and Livestock, and is briefly described in the box below.

The main advantages of the approach are that it:

- Helps in preparing a frame.
- Provides a measure for (a) allocating samples and (b) selecting EAs by the probability proportional to size (PPS) method.
- Elicits data about the distribution of agriculture and livestock, and cashew and coconut crops, across provinces and districts.
- Identifies areas where very small scale specialized types of agriculture or livestock exist for subsequent specialized surveys.

BOX 7 – MOZAMBIQUE
Survey design

The data collected through the agricultural module of Mozambique's 2007 Population and Housing Census (PHC) was used to build an efficient sampling frame and to improve the design of the agricultural census which was conducted as a sample-based survey. Population census enumeration areas (EAs) were the Primary Sampling Units (PSUs). These were geo-referenced using GPS and were digitized. Five scenarios were drawn up, on the basis of data collected in the PHC agricultural module, as a means of deciding how to define the agricultural census coverage (particularly in urban areas). The scenarios were based on households involvement in growing or rearing the following:

- *Agricultural crops*
- *Cashew or Coconuts (with and without cut-offs)*
- *Cows/Bullocks*
- *Small ruminants -goats, sheep or pigs (with and without cut-offs)*
- *Chickens or Ducks (with and without cut-offs).*

Analysing the data in PHC Section G provided the following information about the distribution of households:

No agricultural activities	*27.8 %*
Only agriculture	*24.2 %*
Only livestock	*0.4 %*
Agriculture + livestock	*4.4 %*
Agriculture, livestock + chicken	*9.0 %*
Agriculture, cashew and coconut	*7.7 %*
Agriculture, cashew, cococnut + chicken	*3.8 %*
Agriculture, livestock, chicken, cashew + coconut	*5.0 %*

7.2   Determining sample size (total size, size of PSUs and SSUs)

Sampling textbooks provide the theoretical basis on how to deal with these questions and the two main approaches are:

a) Given a fixed budget, determine the largest and most efficient sample that can be supported and

b) Given a required level of statistical reliability, determine the sample size necessary to satisfy the criteria.

In practice sampling experts use an iterative process to optimize the design, taking into account all available information for the population, since there is always a budget limitation. Agricultural data collected for the entire population during the population and housing census can be of considerable help in optimizing the sampling design. This information can be used to calculate intra-class correlations, which is a parameter used to determine the optimal size of PSUs and SSUs. Data about area of holdings, number of plots, number of livestock, and so on, can be used for this purpose.

Based on the PHC information , a multiple frame approach was adopted (in which large-scale farms on the list frame receive complete coverage, and a sample of small-, medium- and large-scale farms - excluding the large farms already covered - taking the sample from the list frame of EAs):

- *Agricultural households were identified on the basis of Scenario 5.*
- *EAs containing fewer than 15 agricultural households were excluded.*
- *Households were categorized as small, medium or large based on agricultural land and livestock.*
- *The measure of size in the PPS selection was the number of agricultural households.*
- *The sample allocation was also based on number of agricultural households*
- *The main strata for districts was the urban / rural categorization.*

Variables	Urban/	Scenario	Scenario	Scenario	Scenario	Scenario
Section G	*Rural*	*1*	*2*	*3*	*4*	*5*
Agriculture (G1=1)	*U & R*	*All Hhs*	*All Hhs*	*All Hhs*	*All Hhs*	*All Hhs*
Cashew + Coconut	*U*	*-*	*>= 5*	*>= 5*	*>= 5*	*>= 5*
	R	*-*	*>= 5*	*>= 1*	*>= 5*	*>= 1*
Cows	*U*	*>=1*	*>=1*	*>= 1*	*>= 1*	*>= 1*
	R	*>=1*	*>=1*	*>= 1*	*>= 1*	*>= 1*
Goats, Sheep + Pigs	*U*	*>=1*	*>= 1*	*>= 3*	*>= 3*	*>= 3*
	R	*>=1*	*>= 1*	*>= 1*	*>= 3*	*>= 1*
Chicken + Ducks	*U*	*>=1*	*>= 1*	*>= 5*	*>= 5*	*>= 10*
	R	*>=1*	*>= 1*	*>= 1*	*>= 5*	*>= 1*
Agricultural Households		*3 592 103*	*3 691 651*	*3 659 297*	*3 433 733*	*3 611 629*
% of Total Households		*75.0*	*77.0*	*76.4*	*71.7*	*75.4*

The steps involved in determining sample size, allocating it among the different strata and among the sampling stages (PSU and SSU), are generally as follows:

1. Determine the total size of sample, in other words the number of second stage sampling units (SSUs) to be selected, which in this case would be farm households or holdings).

2. Determine the number of holdings (SSUs) to be selected in each primary stage sampling unit (PSUs), which in this case are EAs), and thus the number of PSUs to be selected.

3. Deciding the number of PSUs, in this case EAs to allocate to each strata (which are often the districts).

BOX 8 – UGANDA
Survey design

The original sample size proposed for the 2007 Ugandan census of agriculture was 48 000 households, in order to generate estimates at district level. 3 200 EAs would be selected, with 15 agricultural households selected in each EA. A review by a sampling specialist suggested that almost the same level of reliability could be achieved by selecting approximately 3 600 EAs, with 10 agricultural households selected in each EA. This sample size of 36 000 households was expected to be good enough to achieve at least the same level of efficiency that could be obtained from the earlier proposed sample of 48 000. The analysis leading to this conclusion was:

i) *On the basis of a suitable cost ratio (ratio of the cost per PSU to cost per SSU) and suitable intra-class correlation calculated from the agricultural module of the 2002 population and housing census, an optimum number of households to be sampled per EA was obtained. For a cost ratio of 40 and intra-class correlation of 0.29, the optimum number of households to be selected was found to be 10. The intra-class correlation was worked out for three variables – number of pure plots, number of mixed plots and number of total plots (Ideally, land area under cultivation could have been used to work out intra-class correlation but this information was not available in PHC 2002, whereas the information for numbers of pure, mixed and total plots was). Intra-class correlations for these variables were 0.27, 0.29 and 0.31 respectively. The intra-class correlation used for calculating the optimum number of households was 0.29. However, for each of the ICCs derived the optimum number of households remained close to 10.*

ii) *The design effects, for sampling designs with 15 and 10 agricultural households were 5.06 and 3.61 respectively. Deff is given as:*

$$Deff = 1+(m-1)\rho$$

where ρ is the intra-class correlation (0.29) and m is the number of agricultural households to be selected, 15 and 10 respectively.

iii) *The effective sample size of 48 000 agricultural households was 9 486 (48 000/5.06). To obtain the same effective sample size, with 10 SSUs per PSU, i.e. with Deff as 3.61, one would require 3 425 EAs (9 486 X 3.61/10). In this way, a conservative number of EAs to be selected was calculated at 3 600. It was observed that the variance efficiency of the suggested scheme was 105.5 percent while its cost efficiency was 105.6 percent, making the overall cost-variance efficiency a total of 111.4 percent.*

In determining the sample size for the entire agricultural census plan, certain practical considerations are kept in view in addition to these textbook criteria of cost and variance. Reliable estimates for key variables are required at district level, and the experience gathered in previous censuses about cost structure and variability considerations also play an important role in determining overall sample sizes.

The example from Uganda's 2007 Census of Agriculture shows how it was possible to adjust the originally planned sample size of 48 000 agricultural households down to 36 000 through a judicious application of information from the population census.

7.3   Number of holdings selected in each PSU and allocating SSUs (holdings) within PSUs

The approach is to obtain the optimum sample size at the second stage under a linear cost model.

Let the number of EAs to be selected be n, where holdings to be selected per EA are m. Consider a cost function:

$$C = c_1 n + c_2 nm$$

where C is the total cost for the survey minus the fixed cost which does not depend on n or m, c_1 is the cost per EA (i.e. travel costs to the EA, listing the EA and all other associated costs), c_2 is the unit cost of enumerating one holding (it is the average cost of enumerating all holdings linked to one agricultural household, because the household is the sampling unit). The design effect owing to clustering is given by:

$$Deff = \{1 + (m-1)\rho\}$$

where ρ is the intra-cluster correlation (also known as rate of homogeneity (roh)). The parameter ρ is given by:

$$\rho = \frac{\sigma_s^2}{\sigma_s^2 + \sigma_e^2}$$

and ρ is estimated using σ_s^2 and σ_e^2 in the following equations:

$$E(MSB) = m\sigma_s^2 + \sigma_e^2$$

and

$$E(MSW) = \sigma_e^2$$

MSB and MSW are *between cluster* and *within cluster* mean sums of squares in a one way ANOVA table. ρ can be estimated using past surveys or census data.

The value of ρ can also be estimated from the equation:

$$\rho = \frac{Deff - 1}{m - 1}$$

and $Deff$ can be taken from past surveys. Some data analysis software directly provides the values of $Deff$.

The optimum values of m under the above cost function is given by

$$m_0 = \sqrt{\left(\frac{c_1(1-\rho)}{c_2\rho} \right)}$$

This approach has been tested in Uganda's Census of Agriculture (UCA 2008) and Nepal's Census of Agriculture (NCA 2012).

In NCA 2012, the district-wise design effect, along with the values of roh (referred to as a measure of homogeneity) was available for all 75 districts from the previous NCA in 1991-92. The cost ratio values $\frac{c_1}{c_2}$ were worked out on the basis of a pilot Agricultural Census, and the results were used for working out the optimum number of households to be selected for NCA 2012.

Optimum values of m are given below for different combinations of ρ and $\frac{c_1}{c_2}$

TABLE 2

Optimum number of SSUs (Holdings) per PSU (Ward/EA)

ρ (roh)	c_1/c_2			
	10	20	30	40
0.01	31	44	54	63
0.02	22	31	38	44
0.03	18	25	31	36
0.04	15	22	27	31
0.05	14	19	24	28
0.06	13	18	22	25
0.07	12	16	20	23
0.08	11	15	19	21
0.09	10	14	17	20
0.10	9	13	16	19

For the ρ values lying between 0.01 to 0.05 and values of $\frac{c_1}{c_2}$ between 10 and 30, the optimum value of m was taken to be 25.

Since the total sample is already determined, the number of PSUs to be selected is determined as a follow-up.

7.4   Allocating the sample of PSUs to different strata

Having determined the number of PSUs to be selected, the decision about allocating the total sample size to different strata has to be made before selecting the sample. The following methods are available:

1. Equal allocation
2. Proportional allocation
3. Compromise allocation
4. Optimum allocation.

Equal allocation: In this approach, the sample is allocated equally to each stratum. The sizes of strata vary considerably and equal allocation will provide less efficient estimates at higher levels, as the larger districts will not get due representation in the sample. This type of allocation is therefore not suitable unless the same level of precision is required for each stratum.

Proportional allocation: In this allocation, samples are distributed to strata in proportion to the sizes of the strata. This is good for overall national level estimates but not appropriate for district level estimates. Although estimates for larger districts should have a sufficient level of precision, smaller districts will have less reliable estimates.

Compromise allocation: This approach is an attempt to get a balance between producing reliable district level estimates and reliable national level estimates. Sometimes a "square root" allocation is used, in which the sample is allocated in proportion to $x^{1/2}$, where x is the measure of size. A more general allocation plan is the "power allocation" in which the sample is allocated in proportion to x^{λ}, where λ can take values between zero and 1. A suitable value of λ is obtained by calculating the Deff for national level estimates and district level estimates. In most cases, $\lambda = 0.4$ or $\lambda = 0.5$ is considered good enough.

Optimum allocation (also known as Neyman's optimum allocation): In this method, the variance of the stratified estimator is minimized with respect to a given cost. Let us consider a simple cost function:

$$C = c_0 + \sum_{h=1}^{L} c_h n_h$$

where c_0 is the overhead cost, c_h is the cost for the stratum of observing study variable y for each unit selected in the sample and n_h is the sample of elements in stratum h. After optimization, a fixed cost – minimum variance allocation is given by:

$$n_h = \frac{(C - c_0)N_h S_h / \sqrt{c_h}}{\sum_{h=1}^{L} N_h S_h \sqrt{c_h}}$$

where n_h is the sample of elements in stratum h, N_h is the total number of elements in stratum h, S_h is the standard deviation of stratum h and is the cost for the stratum of observing study variable y for each unit selected in the sample.

When c_h is constant for all strata, then:

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

7.5   Selecting PSUs with Probability Proportional to Size (PPS)

The information available for each EA from the population census can also be used to determine the appropriate measure of size, in probability proportional to size (PPS) sampling, for a sample agricultural census. Data for the number of agricultural holdings or some form of farm area measure in each EA is valuable for this purpose, and this is one of the major uses of the agricultural data from the population and housing census in most countries (see Burkina Faso case study in Annex 4).

Chapter 8

PRODUCING PRELIMINARY RESULTS FROM VARIABLES IN THE AGRICULTURAL CENSUS CORE MODULE

Various types of agricultural tabulations could be produced from an agricultural module in the population and housing census, and an agricultural dimension to the population and housing census tabulations may be of interest. For example, women -by age group and children ever born- could be tabulated according to farm size or whether or not they belong to a farm household.

The agricultural module might also be needed specifically to provide agricultural data when no agricultural census is conducted or when data are needed between agricultural censuses. The module might also be used to cover small-scale agricultural production by households outside the scope of the agricultural census. An agricultural module designed for this purpose could be anything from a few basic questions to a mini-agricultural census, although the limitations of the population and housing census for collecting complex agricultural data should be noted.

For the core agricultural items that can be gathered through the population and housing census, the key indicators used in the tabulation are: farm household status measured as either a farm household (i.e. the household is engaged in own–account agricultural activities) or not a farm household; and area of land used for agricultural purposes. This indicator is based on FAO recommendations for area classifications, taking national conditions into consideration.

For the supplementary items, indicators and tabulation classes should be based on FAO guidelines for the 2010 round of agricultural censuses. The supplementary tabulations show *area of agricultural land,* rather than *area of land used for agricultural purposes* as used in the core tabulations. This is because the supplementary questionnaire provides more detailed information about land use, enabling the concept of agricultural land to be measured according to FAO recommendations. There is not usually much difference between the two measures.

All other variables used in the proposed tables are standard population and housing census items. The indicators and tabulation classes for these items should be based on UN guidelines for the population and housing census.

It is also important to mention that several substantive demographic analyses can be conducted using agricultural data. Three examples of these are presented below.

8.1   Fertility in the farm household sector

Almost every study, for whatever type of population and level of disaggregation, shows that household fertility and incidence of poverty are related. Those households with a large number of children are more likely to be poor

BOX 9 – CANADA
Estimates using linked records from the agricultural and population censuses

The linked database allows the characteristics of the census-farm to be cross-tabulated with the socio-economic characteristics of each of the census-farm operator's family members. Over successive censuses changes were made to the treatment of households with multiple operators.

"In 1971, there were 7,468 households in Canada with two or more operators. Thus, two or more census-farms were matched to each multi-operator household – one farm for each operator – and each of these matches produced a separate linked record. Also, as there is only one operator per household, there cannot be more than one operator per family on the Agriculture-Population Linkage database. As a consequence, this methodology over-estimates some counts such as total households, total families and total persons.

The over-estimation of households, families and persons noted above arose because the "census-farm" was chosen as the basic unit in the database and thus, if the operators of two (or more) census-farms resided in the same holding, the data for this household was replicated for each census-farm within the database."

Bollman, 2009

In some analyses based on the 1986 census, families were excluded if they had more than one operator and were thus associated with two or more census-farms.

"The 1991 to 2006 Censuses of Agriculture allowed respondents to report up to three operators per farm, and all farm operators were included in the matching process. With this additional information, the relationship between family members living in the same household and operating the same farm can be analysed. As well, operators in different households operating the same farm can be included in the analysis."

Bollman 2009

than those with smaller numbers. Nevertheless, the direction of causality between household size and poverty is not entirely clear. Hence, variables that have a crucial impact on fertility such as socio-economic level, and in particular education, need to be taken into account.

Including questions about agricultural activities in a population and housing census, and the possibility of identifying a farm household sector, provides a unique opportunity to analyse the issues of fertility and poverty further. In most countries, the farm household sector is likely to be homogeneous in relation to several variables, making it easier to isolate the impact of fertility on household welfare.

Relationships between the number of children in the household and indicators of family welfare can be analysed initially through simple tabulations. As an approximate indicator of household fertility, a household child-adult ratio can be used. Almost all censuses include questions about the construction materials of housing units, access to utilities and ownership of selected assets (radio, TV, cellular or fixed telephone, refrigerator, and so on). They can be used as indicators of the welfare of the household, in addition to indicators such as education of the adult members of the household (particularly women) and school enrolment among school-age children. Total area of land used for agricultural purposes should also be included. Other variables that may be considered are household composition and labour force participation of members of the household (in agricultural and non-agricultural occupations).

This exploratory analysis should provide baseline results for whether household fertility is related to family welfare, and may suggest new analyses of the inter-relationships among the independent variables. For example, if household fertility is related to owning most household assets, these relationships can be evaluated by constructing tables in which there are some controlled variables such as education level of head of the household, average education level of reproductive age women in the household, and area of land used for agricultural purposes. The analytical possibilities are huge and the findings could be surprising.

In a more advanced stage of the analysis, multiple regression models can be used to better understand the role of fertility in household welfare. An index of family welfare can be compiled using housing construction materials, access to utilities and household assets. Other variables to be included in the analysis are the same variables suggested above: household education indicators, area of land used for agricultural purposes, household composition, and labour force participation of household members, in agricultural and non-agricultural activities.

8.2   Gender analysis in the farm household sector

Whether or not a rural household has access to its own agricultural production unit may have a number of implications for gender relations within the household. Three of these implications are discussed here, all related to the need to involve household members in work on the family plot or in caring for the household's livestock. The requirement for such family labour makes it more likely that any adult women in the household, in particular the spouse of the head of household, will be involved in production, most probably in the capacity of unpaid household workers. The head of household (male or female) may also feel a greater need to get married or to remarry after the loss of a spouse, in order to have an additional family worker to help with production. Finally, the children may be required to help with the farm work, causing them to be withdrawn from school at an early age. This withdrawal may be differential by sex, as boys are called upon more frequently to help with the farm work, but it is also possible that young girls are called upon to do housework while the adult women in the family are needed for farm work.

Possible analyses to ascertain the prevalence of the above scenario might begin with these questions:

- What is the incidence of unpaid family work by women, boys and girls, by age and sex;
- What is the marital/union status of the (male) head of household, by age and sex; and
- What is the school attendance of boys and girls, by age.

Each of these questions should be disaggregated by whether the household is urban or rural and, in the latter case, by whether it operates an agricultural holding. In addition, including extra controls (such as the number of adult household members) is recommended so as to make the data more comparable. For instance, the need to call upon children to help with the farm work or to replace adult women in the housework may be contingent on the presence of other household members such as grandmothers. Similarly, a head of household may feel less compelled to remarry if there are other adult household members who can help with the farm production. The amount of help required with the housework may also depend on the number of children under the age of six who need to be cared for, and it may be appropriate to control for these numbers. Finally, it may be appropriate to control for the socio-economic level of the household, either in terms of ownership of consumer durables or in terms of the education level of the household head.

Households with female headship need to be studied separately as their dynamics may be different from male-headed households, particularly in relation to point 2. While women in charge of a household production unit may also feel some pressure to remarry after losing a spouse, their opportunities for doing so may be more restricted; and if they do, there is a greater chance that headship will pass to the new spouse. Given that many societies place restrictions on women's ability to inherit property, headship may also be taken on by another male family member, to protect the family holding. One would therefore expect the incidence of female headship to be lower in households that have agricultural holdings than in rural households where this is not the case. This is another item worthy of study.

8.3   The elderly in the farm household sector

In many developing countries, the ageing population remains in rural areas while young adults migrate. In such situations, older persons may find themselves without traditional family support and without adequate financial resources to make ends meet. Older women in rural areas are particularly vulnerable, especially when their role is restricted to non-remunerated farm or household work and when they depend on others for survival. Older persons in rural areas often lack basic services and, being less mobile, cannot always access those services that do exist. Aging farmers may not have access to financial and infrastructure services that would help them in working on the land, and potentially lack adequate training in the latest farming methods.

Policies and programmes addressing agricultural production and food security should take into account the implications of rural ageing and the vulnerability of older persons in rural areas, including older farmers, farm operators and agricultural holders.

The Madrid International Plan of Action on Ageing called on governments to strengthen the capacity of ageing farmers through continued access to financial and infrastructure services and training for improved farming techniques and technologies.

The results of the agricultural census, together with the population and housing census, can illustrate the situation of older farmers. These data provide evidence, to inform policy-making and programme planning for agricultural production and to enable them to take the needs of older persons into account.

Relevant analysis should begin with the age and sex of the older farmer/farm operator/agricultural holder, followed by tables of socio-economic characteristics:

- Farm households by age and sex of farm operator/agricultural holder
- Farm households by age and sex of farm operator/agricultural holder and size of household
- Farm households by age and sex of farm operator/agricultural holder and size of agricultural holding (or land used for agricultural purposes)
- Farm households by age and sex and highest educational attainment of farm operator/agricultural holder
- Farm households by age and sex of farm operator/agricultural holder and household income (if income is included in the census)
- Farm households by age, sex and national/ethnic group of farm operator/agricultural holder
- Farm households by age, sex and main occupation of farm operator/agricultural holder (optional: and other working-age members of household)
- Farm households by age, sex and industry of farm operator/agricultural holder (optional: and other working-age members of household)

Tables of land use, land tenure, livestock, crops, aquaculture and forestry, by age and sex of farm operator/ agricultural holder, could also be included.

Taken together, the information in these tables will generally provide a good picture of the characteristics of the older farm operator/agricultural holder for policy-makers and planners.