

Statistical Commission
Forty-eighth session
7 – 10 March 2017
Item 4(i) of the provisional agenda
Items for information: agricultural and rural statistics

Background document
Available in English only

WORLD PROGRAMME FOR THE CENSUS OF AGRICULTURE 2020

Volume 2 Operational Guidelines

DRAFT 28 February 2017

Prepared by FAO



DRAFT 28 February 2017

FAO of the UN

WORLD PROGRAMME FOR THE CENSUS OF AGRICULTURE 2020

Volume 2 Operational Guidelines

2/28/2017

TABLE OF CONTENTS

PART ONE Importance of the census of agriculture and census planning.....	9
CHAPTER 1 INTRODUCTION	11
Background	11
Purpose of Volume 2.....	11
Structure of the book.....	11
The census as a component of an integrated agricultural statistics system	14
Definition and main objectives of the census of agriculture	11
Importance of the census of agriculture.....	11
Relevance of the census of agriculture.....	11
Quantifying the benefits of the census of agriculture	11
Ensuring cost-effectiveness of the census of agriculture	19
CHAPTER 2 LEGAL FRAMEWORK	22
Introduction	22
Legislation on the agricultural census within the national legal framework.....	22
General law or detailed legislation	25
Compliance of census legislation with fundamental principles of official statistics.....	25
Authority for the promulgation and execution of legislation.....	26
Main features of the census legislation.....	26
CHAPTER 3 INSTITUTIONAL FRAMEWORK.....	34
Ensuring political support for conducting an agricultural census.....	34
Census office	36
Central census office.....	37
Provincial census offices.....	38
The census technical steering committee	39
Main responsibilities and functions of the TSC.....	40
Other committees and boards.....	41

CHAPTER 4 PLANNING AND BUDGETING.....	43
Introduction	43
Work plan.....	44
Census budget.....	47
Funding	52
Monitoring and review of the work plan and the budget	53
Preparation of expenditure control.....	54
CHAPTER 5 COMMUNICATION AND PUBLICITY STRATEGY	56
Importance of communication and publicity for the census.....	56
Developing and implementing a communication and publicity strategy.....	57
Timing and duration of the communication program and publicity campaign.....	66
Monitoring	66
Budget.....	67
CHAPTER 6 TABULATION PLAN	68
Introduction.....	68
Main steps in the development of a tabulation plan	69
Evaluation of user’s requirements and user consultations	71
Importance of international comparability	72
Presentation of the tabulation plan.....	72
Cross-tabulations	75
Some examples	77
CHAPTER 7 QUALITY ASSURANCE FRAMEWORK FOR CONDUCTING A CENSUS OF AGRICULTURE	81
Introduction	81
Quality assurance plan for the census of agriculture	82
Managing dimensions of quality during the different phases of a census.....	83
Quality control techniques.....	87
Implementing a quality assurance and improvement programme	88
PART TWO Census modalities.....	92
CHAPTER 8: GENERAL OVERVIEW OF COMMON RECOMMENDATIONS FOR CENSUS MODALITIES	93
Introduction	93
CHAPTER 9: CLASSICAL CENSUS.....	100
Description	100
Ways and steps for implementation of the classical census	100

CHAPTER 10: MODULAR CENSUS APPROACH AND INTEGRATED CENSUS AND SURVEY MODALITY...	108
Description	108
Ways and steps for the implementation of the modular census	110
INTEGRATED CENSUS/SURVEY MODALITY	115
Main advantages, limitations and requirements of this census modality.....	119
CHAPTER 11: USE OF REGISTERS AS A SOURCE OF CENSUS DATA	121
Description	121
Quality consideration when using administrative data for the census of agriculture	122
Steps for the implementation of the combined agricultural census modality.....	127
Advantages, limitations and requirements of this modality	128
PART THREE Census preparation and implementation	132
CHAPTER 12 CARTOGRAPHY AND USE OF MAPS FOR THE CENSUS OF AGRICULTURE AND PREPARATION OF FRAMES.....	133
A. CARTOGRAPHY AND USE OF MAPS FOR THE CENSUS OF AGRICULTURE	133
Introduction	133
Purpose of maps	135
Inventory of available geospatial information and maps	136
Types of maps used.....	136
Timing of cartographic preparation.....	138
B. PREPARATION OF FRAMES FOR AGRICULTURAL CENSUS	139
Definition of a frame	139
Frame requirements for various census modalities	140
Guidelines on building frames for agricultural censuses.....	144
CHAPTER 13 USE OF SAMPLING IN THE CENSUS	149
Uses of sampling techniques in an agricultural census	149
Main types of sample designs for census enumeration	151
Sample designs based on list frames	152
<i>Use of one-stage(element) sampling</i>	<i>152</i>
<i>Use of clustering in single-stage and multi-stage sampling</i>	<i>153</i>
<i>Sample designs for classical censuses.....</i>	<i>153</i>
Sample designs based on area frames.....	156
Sample designs based on multiple frames	158
Sample designs applied at other census stages.....	160

Choice of sample design	160
Main advantages of complete enumeration (over sample enumeration)	163
CHAPTER 14 QUESTIONNAIRES AND INSTRUCTION MANUALS.....	166
Questionnaires.....	166
Census questionnaires working group and user-producers consultations.....	171
Questionnaire design and data processing requirements.....	172
Pre-testing of questionnaires.....	177
Advantages and disadvantages of different types of questionnaires.....	177
Instruction manuals	179
CHAPTER 15 STAFFING.....	189
Introduction	189
Organizational structure of census staff.....	190
CHAPTER 16 TRAINING	203
Organization and logistic of the training programme.....	203
Training of trainers.....	206
Training of supervisors.....	207
Training of enumerators.....	208
Training in writing inspection reports.....	212
Training of office staff.....	213
Training in the use of advanced technologies	214
Use of training aids	214
CHAPTER 17 ORGANIZATION OF FIELD WORK.....	216
Introduction	216
Pre-test surveys and pilot census	218
Organization of census enumeration.....	223
Monitoring and control of questionnaires' flow.....	223
Census field staff.....	224
Supervisory work	225
Enumeration work	228
General suggestions for preparing the face-to-face interview.....	228
Field enumeration kit and tools for face-to-face data collection	229
CHAPTER 18 CENSUS DATA COLLECTION.....	231
Introduction	231

Face-to-face data collection.....	232
Interview	232
Some tips on interviewing	234
Objective measurement	236
Remote data collection methods.....	236
Description of remote data collection methods.....	237
Strengths and limitations of remote data collection methods and comparison with face to face methods	240
Requirements of remote data collection methods.....	244
USE OF TECHNOLOGY FOR CENSUS DATA COLLECTION.....	246
Remote sensing and aerial photos.....	247
Hand - held GPS	248
Using Mobile devices for Census data collection.....	249
Using mobile devices equipped with packages for Computer Assisted Personal Interview (CAPI)..	249
Questionnaire Design, Data capture, quality check and transmission using CAPI	250
Using mobile devices equipped with GPS for Geo referencing holdings.....	251
Mobile devices equipped with GPS for optimizing logistics and supporting enumerators.....	251
Mobile devices with GPS and paradata for monitoring census progress.....	252
Limitations of using Mobile devices with CAPI for census data collection.....	253
Special problems for data collection.....	254
<i>Urban and peri-urban agriculture</i>	256
CHAPTER 19 DATA PROCESSING	262
Introduction	262
Hardware	263
Software.....	264
Testing computer programmes	265
Data processing activities	265
Data coding and entry.....	266
Data entry methods	266
Hand-held devices.....	269
CASI and CATI data entry	269
Data editing.....	270
Manual data editing.....	270

Automated data editing.....	271
Imputation	273
Data Validation	275
Tabulation	276
CHAPTER 20 DATA ARCHIVING	277
Introduction	277
Standards	277
OAIS Reference Model.....	278
Trusted Digital Repository (TDR).....	280
Evaluation and Audit.....	281
CHAPTER 21 SAFE ACCESS TO MICRODATA.....	283
What is microdata?	283
CHAPTER 22 POST ENUMERATION SURVEY (PES)	293
Introduction	293
Non-sampling errors	294
Characteristics of a PES.....	296
Planning the PES	297
Design of the PES.....	298
Training for the PES.....	299
Data collection in PES.....	300
Analysis of PES results.....	302
Presentation of PES results.....	304
CHAPTER 23 DATA ANALYSIS, REPORTING AND DISSEMINATION.....	306
Introduction	306
Dissemination strategy	306
Dissemination plan.....	307
Products and services	308
Methods and tools for dissemination	308
Dissemination products, services, methods and tools	309
Dissemination products and services	309
<i>Providing access to micro-data</i>	318
CHAPTER 24 RECONCILIATION OF CURRENT STATISTICS WITH CENSUS RESULTS.....	326
Reconciliation of Census and Surveys data.....	326

DRAFT

**PART ONE Importance of the census of
agriculture and census planning**

DRAFT

CHAPTER 1 INTRODUCTION

This chapter introduces Volume 2 of the World Programme for the Census of Agriculture 2020 (WCA 2020) as a practical guide to census practitioners who are responsible for conducting the agricultural census. The purpose and structure of the volume are described. It is then emphasized that the census of agriculture must not be carried out in isolation but as a component of an integrated system of agricultural censuses and surveys. Next, the objectives, importance, uses and relevance of the census in the development policy agenda are discussed.

Background

1.1 The World Programme for Census of Agriculture 2020 (WCA 2020) is the tenth round in the decennial programme of agricultural censuses to be conducted during the period 2016-2025. The decennial programme started in 1930s under the auspices of International Institute of Agriculture (IIA) and continued since the 1950s under the leadership of FAO. The WCA 2020 consists of two volumes to clearly separate two distinct aspects of the census:

- ◆ Volume 1 “Programme, concepts and definitions” deals with the methodological and conceptual aspects of the census of agriculture.
- ◆ Volume 2 “Operational aspects”, deals with the practical details on the steps, methods and tools involved in actually conducting the agricultural census.

Purpose of Volume 2

1.2 A well-designed and well conducted census of agriculture is an invaluable source of information for the agricultural sector of a country. A good census involves adequate planning, implementation, use of resources and minimizing, to the greatest extent possible, errors in all stages of the census. Volume 2 of WCA 2020 has been designed to guide national statisticians who are responsible for conducting the agricultural census.

1.3 In the organization of a census of agriculture, in addition to statisticians, there are also other specialists who may be involved in particular aspects of the operation such as publicity, mapping, recruitment and training of staff, data processing, etc. For these specialists, this publication will also provide an insight into all the main aspects of census taking and enable them to better understand their own role within the census organization. The publication is also of interest to the government officials involved in deciding if and when to organize an agricultural census.

Structure of the book

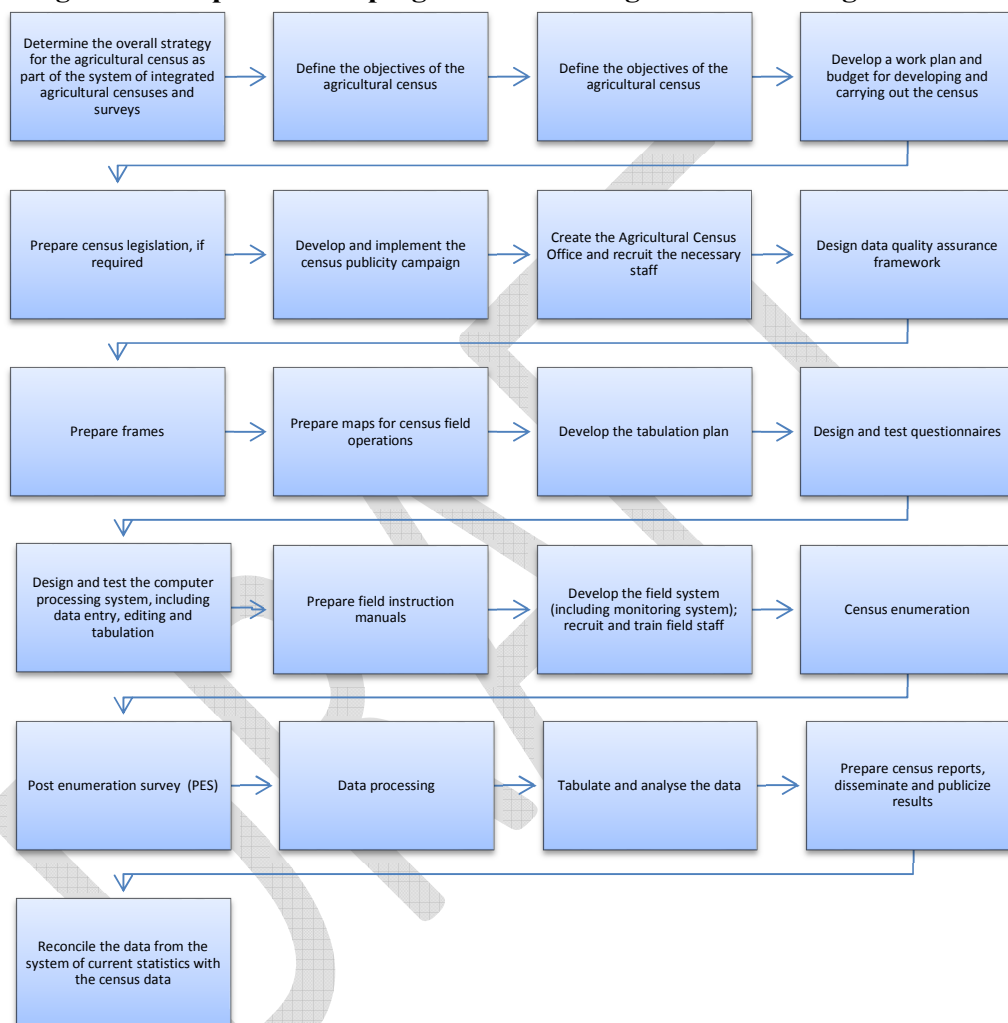
1.4 Volume 2 provides a comprehensive coverage of the main stages in the preparation and implementation of the census of agriculture. However, it does not discuss in detail aspects that are easily available in FAO and other specialized publications and sources. An effort has been made to make the document as user-friendly and practical as possible. This has involved, among others, inserting cross-references between sections, linking the content of different chapters to country practices and hyperlinks to relevant specialised and detailed methodological publications in order to illustrate or provide more guidance on the respective themes as well as to learn from experience in how to overcome practical issues. Bibliographic references have been added at the end of most chapters, for readers seeking further details.

1.5 Once the decision to conduct an agricultural census is taken by the country, many different steps and activities have to be planned. Chapter 6 of Volume 1 listed the basic steps involved in developing and conducting a census of agriculture (see figure below). The steps and associated activities are described in the present document in twenty-five different chapters organised in two

main parts as shown below. The activities are presented in chronological order, to the extent possible:

- ◆ Part 1 covers the planning of the census and necessary framework.
- ◆ Part 2 relates to the methodological approach for the census agriculture from four different modalities introduced in Volume 1, their main issues and suggested solutions.
- ◆ Part 3 refers to the preparation and implementation of the census. The organization of the document follows a logical sequences and, to the extent possible, a chronological order.

Figure 1.1 Steps in developing and conducting the census of agriculture



1.6 Chapter 1 of **Part 1** aims at assisting those responsible for the census of agriculture in making a good case with decision makers and resource partners on why they should invest in the census, what will be done to ensure that value for money is achieved and what are the key factors for successful resource mobilisation. Once the decision is made and the resources are allocated, one of the first steps is to ensure that the legal basis for the census organization exists. This is the subject of Chapter 2 “Legal Framework”. The purpose of this chapter is to present an overview on census legal framework and give some ideas to the national census managers regarding the improvement or introduction of national legislation about the agricultural census.

1.7 Along with the analysis of the existence and characteristics of the census legislation is the setting up of the “Institutional Framework” discussed in Chapter 3. The establishment of a census

office, the structure of the census organization, the establishment of coordinating bodies are all important actions that census managers must make at the very beginning of the census activities.

1.8 The next step is the establishment of a detailed plan of action along with the census budget. It implies the elaboration of a detailed work plan with the different stages of implementation clearly established, a detailed budget where different components of spending are carefully estimated along with the time-table of expenditures and funding. The establishment of a system of monitoring and review of census work plan and budget is key for the success of the operation. All these issues are dealt with in Chapter 4 “Planning and budgeting”.

1.9 An essential part of the census preparation is to sensitize the public about the purpose of the census of agriculture and, ultimately, to ensure the cooperation of holders to provide complete and accurate data. Chapter 5 “Publicity/communication strategy” explains how to develop and implement a cost-effective strategy for a communication program and publicity campaign well synchronized with census phases.

1.10 Census data are to be presented in tables. The preparation of the tabulation plan needs to be performed at early stages of census preparation for defining census content and developing the census questionnaires. Chapter 6 “Tabulation plan” refers to different aspects in the preparation of the tabulation plan.

1.11 Chapter 7 finalizes Part 1 by discussing the “Quality assurance framework”. Quality of census data, their confidence level, the results of different checks of census data, both internally and with external sources, and the evaluation of the Post-Enumeration Survey (PES) are all important elements in the framework of quality assurance of census data. Links to several country examples aid to understand those issues.

1.12 **Part 2** discusses four census approaches and modalities, their requirements, advantages and limitations. Volume 1 of WCA 2020 defined four modalities for conducting an agricultural census:

- ◆ The classical approach: a single one-off field operation usually carried out on a complete enumeration;
- ◆ The modular approach: comprising a core module carried out on a complete enumeration, in conjunction with sample-based census supplementary module(s) to provide more in-depth data;
- ◆ The integrated census and survey modality: involving a core census module carried out on a complete enumeration basis followed by rotating sample-based modules over the years between two censuses.
- ◆ The combined census modality which uses administrative data: makes use of field data complemented by registers and other administrative records as source of census data.

1.13 Chapter 8 presents the general overview and summarizes the main steps for each census modality. Chapters 9 to 11 describes each modality and the challenges that they pose to census staff in their implementation, noting that their use depend on the needs and statistical and technical development of the country.

1.14 **Part 3** is devoted to preparation of census fieldwork and implementation of data collection, analysis and dissemination activities. It covers Chapter 12 to 24 and it is organized as follows:

- ◆ Census preparation, including mapping and preparation of frames, sample design, elaboration of questionnaires and manuals, selection of staff, training, and the overall organization of the field work.
- ◆ Census data collection, involving the steps and issues related to data collection under the four different census modalities, and including use of technology and links to good country

practices.

- ◆ Census data processing and archiving, including safe access to microdata.
- ◆ Data analysis, reporting and dissemination, including the undertaking of PES and the reconciliation of current statistics using census results.

The census as a component of an integrated agricultural statistics system

1.15 Volume 1 re-emphasized that the census of agriculture must not be carried out in isolation but as a component of an integrated system of agricultural censuses and surveys. This integrated system of agricultural statistical activities must, in turn, be a component of the national statistics system consistent with a well-designed National Strategy for the Development of Statistics (NSDS).

1.16 The data requirements for food and agriculture are wide and include information on the structure of agricultural holdings, agricultural production, farm management, agricultural inputs, food consumption, household income and expenditure, labour force, and agricultural prices. These data are provided by decennial agricultural and population censuses, regular agricultural sample surveys, household surveys, administrative records and other sources. On one hand, structural data such as size of holdings, land use, crop areas, livestock numbers and agricultural inputs are collected at the lowest geographical through the decennial census of agriculture. On the other hand, data such as crop and livestock production, food consumption, farm management and agricultural prices, are collected on a more regular basis through sample surveys and/or administrative reporting systems to produce current agricultural statistics. Current agricultural statistics are needed to monitor ongoing agricultural and food supply conditions and to help governments and stakeholders in short-term decision-making.

1.17 Thus, an integrated agricultural statistics system involves a multi-year programme of statistical activities, including both agricultural census and survey activities, to provide all the required data. Volume 1 names some advantages of this integrated system, including preventing duplication of statistical activities, avoiding releasing conflicting statistics, and using standard concepts, definitions and classifications. In this way, the census of agriculture does not need to be overburden with a wide range of numerous items which may affect the quality of collected data. Instead, the census can be focused on a coherent and manageable set of items, in the knowledge that other (non-structural) data needed more frequently are available in a comparable form from regular agricultural sample surveys and other sources.

Definition and main objectives of the census of agriculture

1.18 As defined in Volume 1, the census of *agriculture is a statistical operation for collecting, processing and disseminating data on the structure of agriculture, covering the whole or a significant part of a country*. It is the only statistical operation that produces structural information on agricultural holdings at the lowest geographical and administrative levels and therefore it is an essential source of information for government officials and other decision-makers.

1.19 An agricultural census covers aspects of agriculture that change relatively slowly over time and thus are usually undertaken at least once every ten years. Thus, agricultural censuses are mainly concerned with data on the basic organizational structure of agricultural holdings and usually excludes data that change rapidly, from year to year, such as agricultural production or agricultural prices. Typical structural data collected in a census of agriculture are size of holding, land tenure, land use, crop area, irrigation, livestock numbers, labour and other agricultural inputs. Although in an agricultural census data are collected at the holding level, some community-level data may also be collected.

1.20 For WCA 2020, the main objectives of the census of agriculture are:

- ◆ To provide data on the structure of agriculture, especially for small administrative and geographical units, rare items, and to enable detailed cross-tabulations;
- ◆ To provide data that can be used as benchmark for and reconciliation of current agricultural statistics;
- ◆ To provide frames for agricultural sampling surveys.

Importance and uses of the census of agriculture

1.21 The census of agriculture gives a snapshot of the structure of the agricultural sector in a country and, when compared with previous censuses, it provides an opportunity to identify trends and structural transformations of the sector, and points towards areas for policy intervention. Census data are also used as a benchmark for current statistics and their value is increased when they are employed together with other data sources. Often, data users see the need for more in-depth studies of specific domains of the agriculture sector and rely on the census as the frame for specific sample surveys focusing on particular themes. In this way, the census provides the basis for addressing a wide range of data needs. Volume 1 provides a detailed discussion of the importance of the census of agriculture in satisfying the needs of both data users' and data producers as summarised below.

1.22 For data users' needs the census of agriculture:

- ◆ Supports and contributes to evidence-based agricultural planning and policy-making.
- ◆ Provides data to facilitate research, investment and business decisions both in public and private sector.
- ◆ Contributes to monitoring environmental changes and evaluating the impact of agricultural practices on the environment such as methods of ploughing, crop rotation or sources of high GHG emissions.
- ◆ Provides relevant data on work inputs and main work activities, as well as on the labour force in the agriculture sector
- ◆ Can provide an important information base for monitoring some key indicators of the Sustainable Development Goals (SDGs), in particular those goals related to food security in agricultural holdings, the role of women in agricultural activities and rural poverty (see also paragraphs 1.27-1.28 below).
- ◆ Provides baseline data both at the national and small administrative and geographical levels for formulating, monitoring, and evaluation of programmes and projects interventions.
- ◆ Provides essential information on subsistence agriculture and for the estimation of the non-observed economy and, plays an important role in the compilation of the national accounts and the economic accounts for agriculture.

1.23 For data producers' needs, the census of agriculture:

- ◆ Provides a reliable benchmark for reconciling and improving current crop and livestock statistics.
- ◆ Provides frames for sample surveys in the agricultural survey programme, as well as information for building the Master Sample Frame.
- ◆ Supports the establishment or update of the statistical farm register.

1.24 Chapter 3 of Volume 1 discusses in more detail the importance of the census of agriculture for both users and data producers in a country.

Relevance of the census in the development policy agenda of the 21st Century

1.25 WCA 2020 has been launched at a crucial time for the international statistical agenda, in particular in the context of the 2030 Sustainable Development Agenda and the Busan Action Plan

for Statistics. Furthermore, the *Global Strategy to Improve Agricultural and Rural Statistics* has been developing methodologies that reinforce the conduct of censuses and associated surveys in the 2016-2025 round.

1.26 The **2030 Sustainable Development Agenda** (SDA) adopted by the UN in September 2015 defines 17 Sustainable Development Goals (SDGs) and 169 individual targets, including 19 multidimensional agricultural-related SDG targets and 25 global indicators for monitoring the progress towards the goals and targets. The SDGs present new demands for more data and challenges in terms of monitoring and reporting progress towards their achievement. There is a need to strengthen countries' capacity to adopt new statistical standards and cost-efficient methodologies, modern tools for data collection (e.g. mobile devices, remote sensing, geo-referencing devices etc.) and new data sources as recommended in the **Global Action Plan for Sustainable Development Data**¹. These aspects have been taken into account in the WCA 2020 to assist member countries in the planning and implementation of the census of agriculture.

1.27 The census of agriculture provides support to monitoring indicators of SDG 1 (end poverty in all its forms everywhere) and SDG 5 (achieve gender equality and empower all women and girls). It can provide data that contribute to monitoring SDG target 2.3 on productivity and income of smallholders, target 2.4 on sustainable food production systems, 5.4 on unpaid domestic work, and 5.a.1 on ownership or secure rights over agricultural land. More specifically, the census of agriculture can contribute to essential information for several SDG indicators including:

- ◆ 2.1.2: Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES, when this module is included in the census).
- ◆ 2.3.1: Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size.
- ◆ 2.3.2: Average income of small-scale food producers, by sex and indigenous status.
- ◆ 2.4.1: Proportion of agricultural area under productive and sustainable agriculture.
- ◆ 5.4.1: Proportion of time spent on unpaid domestic and care work, by sex, age and location.
- ◆ 5.a.1.a: Proportion of total agricultural population with ownership or secure rights over agricultural land, by sex.
- ◆ 5.a.1.b: Share of women among owners or rights-bearers of agricultural land, by type of tenure.

1.28 Furthermore, the census of agriculture underpins the statistical system which monitors the SDGs, providing the sampling frame for the agricultural survey programme and a benchmark for the national agricultural statistics system. When the integrated census and survey programme modality is used, a wider set of data could be collected through the rotating modules operating over a ten-year cycle. This modality provides information on the rural population active in agriculture for 16 additional indicators².

1.29 The **Busan Action Plan for Statistics** adopted in 2011 supports three principal objectives: i) Fully integrate statistics in decision-making through improvements in statistical production process, relevance, quality and effective use by policy-makers; ii) Promote open access to statistics by providing timely and reliable statistical data which increases government effectiveness and public confidence; and iii) Increase resources for statistical systems through coordinated donor assistance strategies consistent with countries' national priorities. The plan recognizes the important synergies between survey and census data, administrative data and vital statistics and it explicitly supports

¹ **Global Action Plan for Sustainable Development Data**

Prepared by the High-level Group for Partnership, Coordination and Capacity-Building for statistics for the 2030 Agenda for Sustainable Development (HLG-PCCB), Oct 2016.

² SDG indicators 1.1.1, 1.2.1, 1.2.2, 1.3.1, 1.4.1, 1.4.2, 2.5.1, 2.5.2, 5.b.1, 7.1.1, 8.5.1, 8.5.2, 8.7.1, 8.8.1, 9.1.1 and 17.8.1. Agricultural Integrated Survey (AGRIS) - Rationale and methodology: outline. Global Strategy internal document. September 2016.

greater transparency and encourages the use of new methods and technologies to increase the reliability and accessibility of official statistics.

1.30 WCA 2020 reflects these priority areas by emphasizing the need for an integrated census and survey programme prepared in close consultation with users, thus improving its relevance and the effective use of statistical data by policy-makers. It promotes the use of new technologies as a way to improve the timeliness, reliability and accessibility of statistics.

1.31 The **Global Strategy** to improve agricultural and rural statistics is an initiative prepared under the auspices of the United Nations Statistical; Commissions (UNSC) to provide a blueprint for long-term sustainable agricultural statistical systems. Its Global Action Plan (2012) defines the technical assistance, training and research plans as well as the governance mechanism. The Global Strategy has developed cost-effective methodologies and tools for efficient conduct of censuses and surveys. Some of this work which is available on the Global Strategy's website³ includes:

- ◆ Handbook on Master Sampling Frames for Agricultural Statistics.
- ◆ Handbook on Agricultural Cost of Production Statistics.
- ◆ Guidelines for the Enumeration of Nomadic and Semi-Nomadic (Transhumant) Livestock
- ◆ Guidelines to Enhance Fisheries and Aquaculture Statistics through a Census Framework
- ◆ Access to Agriculture Microdata: A Guide.
- ◆ Methodology for Collecting and Using Administrative Data in an Agricultural Statistics System.
- ◆ Cost-Effectiveness of Remote Sensing for Agricultural Statistics in Developing and Emerging Economies.
- ◆ Use of GPS, GIS and Remote Sensing in Setting up Master Sampling Frames.
- ◆ Linking Area and List Frames in Agricultural Surveys
- ◆ E-Learning Course on Linking Population and Housing Censuses with Agricultural Censuses.
- ◆ E-Learning Course Using Computer Assisted Personal Interviewing (CAPI) for Agricultural Surveys.

1.32 Volume 2 builds on a wide range of existing methods, tools and publications produced during recent years, including those listed above and through other relevant initiatives such as the World Bank Living Standard Measurement Surveys/Integrated Surveys on Agriculture⁴. Readers are referred to those publications throughout the document for further detail. These tools and publications should be used for efficiency savings in census taking, improving timeliness, reliability and accessibility of census data. The potential efficiency savings together with quantifying the benefits of the census, where possible can strengthen the case for the census when mobilising resources for the census.

Quantifying the benefit of the census of agriculture

1.33 As public sector budgets tighten, many governments and donors demand increased accountability and across the world, producers of statistics are coming under increasing pressure to justify the cost of producing statistics. Large statistics programmes, such as the census of population or the census of agriculture need to demonstrate the benefits (both qualitative and quantitative) that they will deliver in order to make a convincing case for funding. The general benefits case is often logically or qualitatively clear as indicated in paras 1.8 to 1.18 above. Numerous critical uses have been mentioned, some of which can be underpinned by legislative requirements. Some of the benefits generated through the use of the data can be quantified, whilst other benefits of the data are more difficult to measure, but are nonetheless important and should be noted in any cost-benefit analysis for conducting a census. Some of these benefits depend on statistical agencies being open with information to encourage and inform debate about the

³ Global Strategy www.gsars.org

⁴ See:

<http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:23512006~pagePK:64168445~piPK:64168309~theSitePK:3358997,00.html>

effectiveness of government and government policies. Therefore, key to the planning of the census is to ensure that there is some identification of the benefits (whether estimated in monetary terms or not) and that the plans focus on realising these benefits. Census managers often need to go further than listing the benefits and quantifying in monetary terms, some of the benefits delivered to further strengthen the case for the census.

1.34 The quantification of the benefits of statistics is a challenging area because statistics in themselves do not deliver benefits; it is *the use of statistics that delivers benefit* - through better and/or timelier decisions by governments, companies and individuals. However, this does not mean statistics producers can avoid estimating benefits – governments and other funding organisations need to decide spending priorities and statistics producers need to provide them with evidence to justify expenditure on statistics (as opposed to other priorities).

A technical paper prepared by the Office for National Statistics - responsible for *statistics in England and Wales, UK (ONS)* on possible methods and guidance for *quantifying the financial benefits of agricultural census* is provided in Annex .. to this volume 2 ([link to ONS technical paper](#)). The guidance and recommendations provided are generic and individual countries may have their own guidance for such exercises. The advice provided should not supersede any guidance issued by individual countries; one of the most important things is to ensure that any cost-benefit analysis or benefit quantification is conducted in a manner that first of all meets the needs of the decision maker responsible for its approval. The paper by ONS is based on information from work done on financially quantifying the benefits of the population census.. In the case of the census of agriculture, the quantification of the benefits should be conducted to inform a *cost-benefit analysis. This involves comparing the benefits of a (proposed) course of action to the costs - to either establish the net present value (NPV) or the benefit to cost ratio.* The higher is the NPV, the better; and the greater the benefit to cost ratio, the better. A negative NPV, or a benefit to cost ratio of less than one would indicate that a project is not worth pursuing on economic grounds (it may make sense on other grounds - for example - official statistics may be needed to meet legislative requirements). The ONS paper provides more details on steps and possible techniques that can be considered for quantifying the benefits of a census.

1.35 One particular aspect that is hard to quantify in monetary terms is the social and distributional impacts of better policy making and the role data plays in that process. The consequences of poor decision making will differ across the World; in some countries – it will impact prices and overall efficiency, in other countries it may be a matter of life or death. The impact of poor decisions may be especially felt by vulnerable groups including children, women, older people, disabled people and those in poverty. These issues need to be clearly set out in any ‘business case’ but attempting to put monetary values to them is challenging technically and ethically/morally. Benefits of statistics are realised by users. The more users and the more they use the data, the greater the benefit. Greater benefit can therefore be achieved by expanding the dissemination of and facilitating the access to census results.

1.36 Quantifying the benefits of statistics in monetary terms is difficult but increasingly necessary to robustly justify the cost of producing statistics. It is important to be clear about what question needs answering before starting work and to agree the approach with the decision maker upfront. Engaging with users is essential for getting data, corroboration and ensuring the work is objective. Various techniques can be used and different techniques are needed for different uses and users. Assumptions have to be made and these should be clearly stated, ensuring all assumptions have some underpinning evidence. An important element for making a strong case for the census is to demonstrate that it will be conducted cost effectively and that there will be ‘value for money’.

Ensuring cost-effectiveness of the census of agriculture

1.37 The census should be planned and carried out as inexpensively as possible without compromising the objectives and the quality of the data. Therefore in a given country context, the census strategy should aim at 'minimising costs by (a) adopting more efficient data collection, data capture and data processing approaches and related technologies, b) contracting out appropriate parts of the operation, c) exploring possible sources of alternative funding and, if appropriate, developing proposals for cost recovery and income-generation, d) international collaboration and reuse of systems, (e) encouraging public to self-complete forms online or on paper where possible, and (g) replace direct collection of data with use of administrative data' (Handbook on Management of Population Census).

1.38 At an early stage, decision should be made on the most suitable census approach or modality applicable to the country. This should be done analysing the advantages, disadvantages and requirements of each modality or approach as they are discussed in Part 2 and to what extent they respond to the specific country situation and data needs.

1.39 Whatever the modality, efforts should be made to minimise the cost of the census through careful analysis of the cost structure and identifying possible sources of efficiency saving without negatively impacting on the quality of data. An analysis of data on census cost available to FAO provides an indication of cost structure and unit cost across a variety of countries and regions⁵.

1.40 A major budget item contributing to census cost in most countries is the field data collection, accounting for 40% to more than 60% of the total census budget cost in some developing or transition countries (and up to 88% in some developed countries such as Italy). A large amount of this cost is provided for the payment of salaries and allowances to the field personnel. Materials and supplies, particularly vehicles for transportation can also be a high contributor to the overall census cost in some countries, while the cost of census management team can be a significant share of the budget in other countries. On the other hand it is striking that the cost of processing, analyzing and dissemination of census results is often allocated a relatively limited share of the census budget (from 5% to less than 15%).

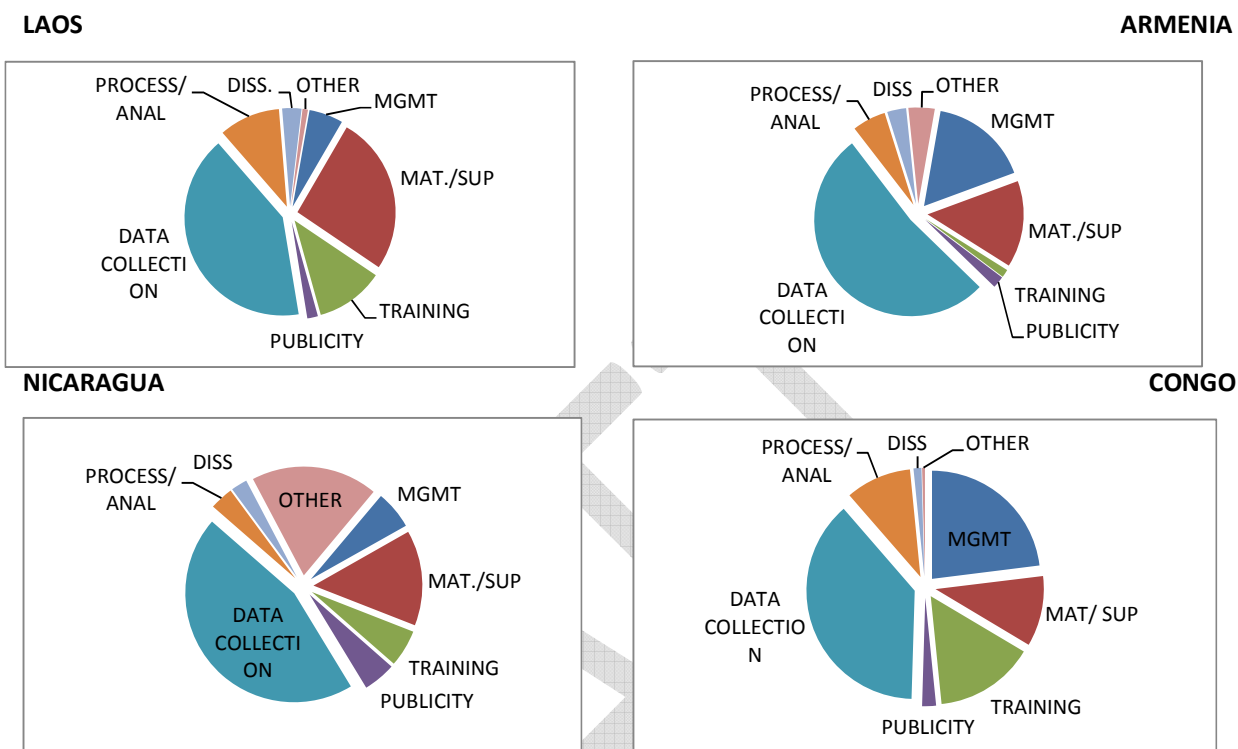
Table 1.2 Indicative structure of census cost by main budget components (compiled from selected developing and transition country projects available with FAO)

BUDGET COMPONENTS	STRUCTURE (%)
CENSUS MANAGEMENT	5-23
MATERIAL AND SUPPLIES	10-26
TRAINING/CAPACITY BUILDING	1-15
PUBLICITY/COMMUNICATION	2-5
FIELD DATA COLLECTION	40-60 *
PROCESSING/ANALYSIS	5-15
DISSEMINATION	1-3

* In some developed countries such as Italy, data collection cost may be more than 88% of total budget.

⁵ The data analyzed comes from budgets (excluding technical assistance) of census projects supported by FAO in 8 countries (2 from Africa, 2 from Asia, 2 from Latin America and 2 from CES Europe). The data are very indicative and may differ from actual final budgets. Also despite efforts to harmonize the content of budget coverage and cost items in every budget line, the numbers are not always fully comparable. Further analysis and adjustments are needed for complete comparability, including adjusting salary levels taking into account the general living cost (using for example PPP). However despite all the limitations, indicative tendencies can be seen and major factors contributing to cost can be identified.

Figure 1.1- Share of costs in a census budget in selected countries:



1.41 Therefore, the potential for significant efficiency cost saving lies in the high contributors budget items to overall census cost. When applicable, strategies that favor the use of other data sources (such as administrative registers), remote data collection and coordinating and building on a recent population census will have an important impact in reducing the cost of the agricultural census.

1.42 The analysis of unit cost per holding shows a wide diversity among countries with costs ranging from around 2 US \$ to above 20 US \$ per holding in developing and transition countries⁶. External factors beyond the control of census planners and managers such as the population density in the country (number of holding per square km) and the level of salaries are important factors that play a role in determining the unit cost. Also, the existence and use of previous human and equipment infrastructure (for example in well developed statistical structures or from previous population census) have an impact in reducing the cost of the agricultural census. However, field staff management and remuneration strategies seem to play an important role. For example, when a performance based salary/allowance system is used, the unit cost tend to be lower as compared to fix monthly salary system. However, care should be taken to avoid any negative impact on data quality. Also, mobilizing existing personnel and equipment (including staff for census management unit), using CAPI to reduce time spent in the field and for data processing may have an impact in reducing the cost.

⁶ Data from EU countries show a wider range from 2 to 74 euros

1.43 The selection of the census modality is a key decision, taking into account the specificity of the country in terms of number of holdings to be covered, density, salary levels availability of suitable infrastructure for field work and whether or to what extent sampling should be used instead or in combination with complete enumeration. A country with low density and large number of small holdings (several millions) and high salary level may select a strategy with more important sampling component while a high density country with low salary levels and a relatively small number of holdings (hundreds of thousands of holdings) may put more emphasis on complete enumeration. The details regarding census planning and budgeting are presented in Chapter 4.

Box 1.1 Country example: Moldova

For its last census of agriculture conducted in 2010, census planners in Moldova managed to significantly reduce the initial budget by almost 1/3. Some of the cost reduction actions include:

- ◆ *Reducing questionnaire size and complexity for complete enumeration: from the analysis of pilot census results, it appeared that some questions were too complex and contributed to extend the time spent on each enumeration (such as number of working days on the holding per each household member of working age). These type of questions were simplified or reserved for follow up sample surveys. As a consequence, the number of holdings per enumerator was increased, resulting in the reduction of the time and cost for field data collection.*
- ◆ *Combining complete enumeration of agricultural holdings above the established thresholds with the sample enumeration of smallest agricultural producers below the thresholds.*
- ◆ *Using existing infrastructure such as buildings in local administrations and other existing equipment and personnel, including staff for the census management. The country had a well established communication and public relation service in place as well as a good IT system.*
- ◆ *Procurement of goods and payment of salaries for field staff were allocated between Donors contribution and Government contribution with the view of achieving cost reduction (e.g. exemption of value added tax, social security costs in the case of procurements/ payments from donors' funds).*

CHAPTER 2 LEGAL FRAMEWORK

The census legislation is one of the first aspects to be considered when starting to plan the census of agriculture, since it constitutes one of the most important instruments for facilitating the census work. Legal basis for the census is required for designating the agency responsible for the organization of the census, making provision for the necessary funds, determining the general scope and timing of the census, obligation to respect confidentiality of the respondents' data, obligation of respondents to provide accurate data to the best of their knowledge, etc.

The agricultural census legislation exists within overall national legal and administrative frameworks. Since these frameworks may differ greatly between countries for historical and other reasons, there can be no single approach to the development of a census legislation. The purpose of this section is to present an overview on census legal framework and give some ideas to the national census managers regarding the improvement or introduction of national legislation in taking an agricultural census.

Introduction

2.1 The existence of an appropriate legal framework is one of the key conditions for the successful implementation of the census of agriculture. Agricultural censuses as other comprehensive statistical operations entail major commitments, especially of resources, and it is essential that adequate and timely legislative provision be made for their preparation and conduct. If a country lacks an appropriate legal framework for taking periodic censuses, it is important to act early to establish it.

2.2 In general, legal provisions for conducting the census are required for: establishing and regulating primary administrative responsibility, such as designating the office responsible for the census organization; obtaining the necessary funds; determining the general scope and timing of the census; placing a legal obligation upon the respondents to cooperate and provide truthful information, a legal obligation upon the enumerator to record the responses faithfully, and specific responsibilities upon other census field personnel at various supervisory levels, etc. It is critical that the confidentiality and protection of the holders' information be strongly and clearly established in the census legislation and guaranteed by adequate sanctions so as to provide a basis for the confident cooperation of the public and provision of reliable data⁷.

2.3 The content of the census legislation inevitably depends on national legal practices and procedures, as well as on the organization of the national statistical system and of the civil service. The census legislation is, in many countries, an integral part of legislation on statistics in general. In some countries, a specific agricultural census legislation is in place.

Legislation on the agricultural census within the national legal framework

2.4 The agricultural census legislation comprises the collection of laws, regulations, resolutions, etc. governing agricultural census activities. The census legal framework commonly consists of:

- ◆ Basic or primary legislation enacted by a legislature or other governing body and

⁷ UN (2003). Handbook on the Management of Population and Housing Censuses (draft, rev.2), p.43

- ◆ Delegated legislation (also referred to as “subordinate legislation” or “subsidiary legislation”), made by an executive authority (such as the Cabinet of Ministers (i.e. Executive Council/Government), the ministry of agriculture, etc.) under powers delegated by an enactment of primary legislation.

2.5 Primary legislation generally consists of "acts" (“Principal Act”, such as “Act of Parliament”, etc.), that set out broad outlines and principles, but delegate specific authority to an executive branch to make more specific laws under the aegis of the Principal Act. The executive branch can then issue delegated legislation (mainly via its regulatory agencies), creating legally enforceable regulations and the procedures for implementing them. In some countries, in the delegated legislation distinctions are made between secondary and tertiary legislation.

2.6 The historical, cultural and political factors of each country determine the specificity of its census legislation. In some countries, specific primary agricultural census legislation is in place. In other countries there is no separate primary national legislation governing agricultural censuses.

2.7 In many countries the census legal framework is based on the primary legislation of general nature, such as governing all official statistical activities in the country (to be referred to as a “statistics law”)⁸ or the law establishing the Ministry of Agriculture⁹, or other institution with the explicit mandate for the agricultural censuses.

2.8 Usually, statistics law grants a specific agency in the government the authority to gather a wide range of official statistics. In some statistics laws there is an explicit provision regarding conduct of agricultural censuses, in other laws there is a general provision empowering the statistical agency to organise the collection of wide ranging official statistics, via various data collections, including censuses and sample surveys.

2.9 However, in some countries specific agricultural census laws are adopted (e.g. in Albania, Armenia, Bangladesh, Bulgaria, Hungary, India, Italy, Kirgizstan, Macedonia, Montenegro, Russia, Serbia). Such a census law may prescribe the conduct of censuses on a regular basis or may be set up before each agricultural census. In the latter case, the census legislation should be established well in advance to allow the proper census preparation and implementation. Often ad hoc census legislation provides more details regarding the specific census and contains the census topics as well spelled out, thus providing additional legal weight to the composition of the questionnaire(s) and the content of the census¹⁰. However, the former approach to census legislation is more favourable for establishing and maintaining a sustainable system of periodic censuses.

2.10 In other countries the legal basis for the collection of agricultural statistics through censuses and other surveys is granted by the Law (Act) on Agricultural Statistics (e.g. in Germany, United Kingdom, etc.) or by the Law on Agriculture (e.g. in Switzerland).

2.11 The subsidiary legislation, is adopted in accordance with the primary legislation of general nature or/and specific agricultural census law and has the purpose to complete the legal framework necessary for the timely and quality implementation of the agricultural census. This may include:

- ◆ Decree of the President of the country (e.g. in Italy) or Royal Decree (e.g. in Belgium) on the organisation of the agricultural census;

⁸ The examples of such countries are: Austria, Canada, China, Croatia, Estonia, Finland, Germany, Greece, India, Iceland, Indonesia, Ireland, Latvia, Lithuania, Malta, Moldova, Netherlands, Norway, Portugal, Romania, Slovakia, Slovenia, Switzerland, etc.

⁹ For example in Paraguay

¹⁰ UN (2015). Principle and recommendations for population and housing censuses, revision 3. New York. (paragraph 2.72, p.49)

- ◆ Decrees issued by the national Government (Executive Council) on the conduct of the census (e.g. in Armenia, Cambodia, China, Kirghizstan, Latvia, Romania, Moldova, Peru, Russia);
- ◆ Annual and Multiannual Statistical Programmes and Plans, approved by the national Government, Royal Decree or other competent institution/body (e.g. in Estonia, Czech Republic, Mozambique, Netherlands, Spain, Slovenia)
- ◆ Resolutions, orders issued by the census agencies, such as the Ministry of Agriculture or the National Statistics Office (common practice for all countries), etc.

2.12 In both cases mentioned above, i.e. a primary legislation of general nature and of a specific census law, the census authority could be empowered by law with different competences in census undertakings. Whatever approach is adopted, the primary legislation completed with secondary legislation should include all necessary elements for the implementation of the agricultural census (see paragraph 2.22), in line with UN fundamental principles of official statistics (see paragraphs 2.18-2.19).

Box 2.1 Country example: Lithuania

The Agricultural Census 2010 was conducted according to the Commission Regulation of the European Parliament and of the Council, No 1166/2008 of 19 November 2008 on farm structure surveys and the survey on agricultural production. **The national legislation** for the implementation of the census consisted of:

- ◆ Law on Statistics of the Republic of Lithuania (Official Gazette, 1999, No VIII-1511);
- ◆ Resolution of the Government of the Republic of Lithuania No 516 of 27 May 2009 on the Agricultural Census 2010 of the Republic of Lithuania (Official Gazette, 2009, No 67-2700);
- ◆ Order No DJ-32 of 28 January 2008 of the Director General of Statistics Lithuania on the approval of the work plan for the Agricultural Census 2010;
- ◆ Order No DJ-163 of 21 August 2008 of the Director General of Statistics Lithuania on the formation of an organizational methodological working group for the Agricultural Census 2010;
- ◆ Order No 174 of the Director General of Statistics Lithuania of 22 July 2009 on the approval of the composition of the High-Level Commission for the Agricultural Census of the Republic of Lithuania 2010 (Official Gazette, 2009, No 89-3825);
- ◆ Order No 36 of the Director General of Statistics Lithuania of 28 January 2010 on the approval of a questionnaire for the Agricultural Census 2010 of the Republic of Lithuania (Official Gazette, 2010, No 17-817).

2.13 In the case of countries with federal constitutions, the legislation may define the relationship between the federal census agency and the census agencies located in the governments of members of the federation and other government agencies of the members of the federation¹¹.

2.14 Related international agreements entered into by countries within regional unions or commissions (e.g., European Union¹²) to carry out agricultural censuses may constitute the legal basis for census taking in participant countries.

2.15 One of the first steps to be taken when agricultural census legislation is being prepared is to consider any relevant legislation the country may have and any international undertaking it may have

¹¹ UN (2003). Handbook of statistical organization. Third edition: The operation and organization of a statistical agency, p. 39

¹² As for international commitments of European Union's member countries, these relate in particular to a regulation of the European Parliament and of the Council, namely Regulation (EC) No 1166/2008 of 19 November 2008 on farm structure surveys and the survey on agricultural production (with EEA relevance). EU member countries proceeded to their own censuses pursuant to this regulation until 2016. A new census legislation was under preparation at the time the publication was published.

entered into. Typically, a starting point will be the law governing all official statistical activities, if available.

General law or detailed legislation

2.16 Countries differ with respect to the degree of detail in their primary census legislation. Both general and detailed census laws offer benefits and have drawbacks.

2.17 On the one hand, detailed laws may allow key actors to have a great deal of protection in activity, e.g. from political intrusion once it has been adopted. On the other hand, the more detailed is the law, the less flexible is to adjust to changing circumstances. Over time, changes in the country context and other unforeseen circumstances would require legal changes and it is always very difficult to awaken political interest in modifying a primary census legislation. Thus, a more generally formulated law gives a greater deal of flexibility to the census agency. What this suggests is that in drafting the census legislation a workable compromise between these two possibilities should be found, taking into account country's peculiarities¹³ (see also paragraphs **2.23-2.25**).

2.18 Broadly speaking, the general pattern followed in census legislation is for a Principal Act to order census taking, to state general provisions about the census implementation and to empower the Cabinet (i.e. government) or a governmental organisation, such as a ministry, to prescribe rules where otherwise a time-consuming parliamentary procedure would be needed.

Compliance of census legislation with fundamental principles of official statistics

2.19 A census of agriculture as a statistical operation for collecting, processing and disseminating data on the structure of agriculture is an integral part of the national system of official statistics in a country. The census of agriculture is expected therefore to fully encompass the Fundamental Principles of Official Statistics, FPOS (UNSC, 1994).

2.20 The FPOS (presented in Box 2.2) state that all organisations that are responsible for producing official statistics must:

- ◆ Compile and disseminate them in an impartial manner.
- ◆ Select their methods based on purely professional considerations (strict scientific principles and ethical rules).
- ◆ Ensure international comparability.
- ◆ Ensure the confidentiality of individual data collected from respondents, etc.

Box 2.2 The UN's Fundamental Principles of Official Statistics¹⁴

Principle 1: **Relevance, impartiality and equal access**

Principle 2: **Professional standards and ethics**

Principle 3: **Accountability and transparency**

Principle 4: **Prevention of misuse**

Principle 5: **Sources of official statistics**

Principle 6: **Confidentiality**

Principle 7: **Legislation**

Principle 8: **National coordination**

Principle 9: **Use of international standards**

Principle 10: **International cooperation**

[See more details regarding FPOS](#)

¹³ UN (2003). Handbook of statistical organisation. Third edition: The operation and organisation of a statistical agency, p.39

Authority for the promulgation and execution of legislation

2.21 Powers to order the taking of a census vary with the legislative systems of the respective countries. In keeping with the general patterns of law-making, primary legislation will emanate from the legislative assembly, usually with the formal assent of the Head of State. In most cases, this empowers the Cabinet (government) or a governmental organisation, such as a ministry, or charge the appropriate agency respectively to issue enforcement decrees and prescribe operational procedures.

2.22 While the authority in charge of technical work is generally the national statistics office, the census executing authority (or “census agency”) varies considerably from country to country. In many countries the national statistics office or ministry/the executive branch of the government charged with agriculture (such as ministry of agriculture) has both administrative authority and responsibility for the technical work to conduct agricultural censuses. In a number of countries the census implementation is under the joint responsibility of these and possibly may involve other authorities, including the local governments. However, regardless of the formal census executing authority of the country, a good cooperation between the ministry charged with agriculture, the statistics office and other relevant central and local governments is a prerequisite for successful implementation of an agricultural census. According to good country practices, the census legal framework clearly specifies the responsibilities of the authorities involved in the census implementation.

Box 2.3 Country example: Niger

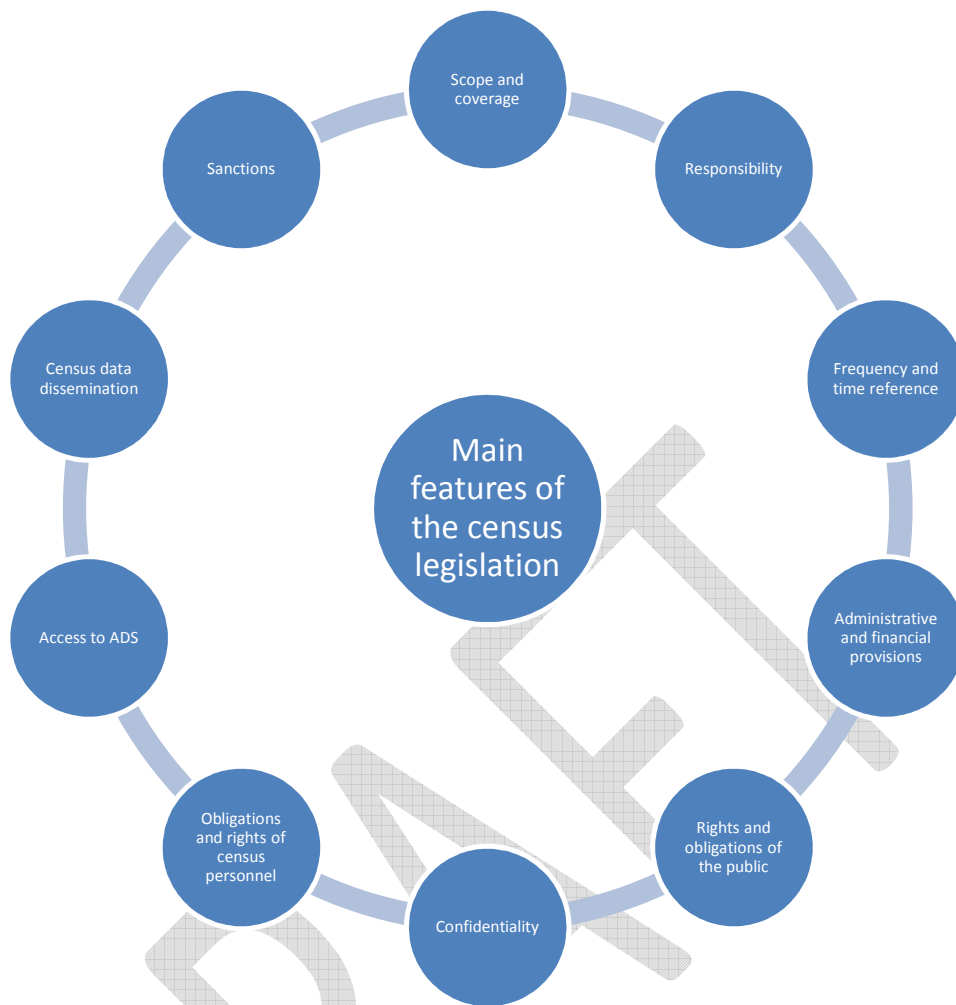
General Agricultural Census (Recensement Général de l’Agriculture et du Cheptel, RGAC) 2004-2008.

The General Census of Agriculture in Niger was designed and implemented jointly by the Ministry of Agricultural Development and the Ministry of Animal Resources, working closely with the National Statistics Institute of the Ministry of Finance and Economy.

Main features of the census legislation

2.23 While the content of the census legal framework (primary and delegated legislation) will inevitably depend on national legal practices and procedures, as well as on the organization of the national civil service, this should normally deal with the following topics indicated in Figure 2.1 and further discussed:

Figure 2.1 Main elements of the census legal framework



Scope and coverage of the census

2.24 Some census laws are quite detailed, e.g. even prescribing the items to be included in the questionnaires or, in order to avoid overburdening of respondents, foresee the maximum number of the units participating in the census operation. In the primary census legislation of other countries, only general directives are given, thus allowing freedom of interpretation to the census executing authorities.

2.25 The inclusion in the primary legislation of too rigid provisions, such as the exhaustive list of census items to be collected, is undesirable. Rather, necessary details should be contained in the census regulations adopted by the census authorities. In order to ensure the relevance of census information and its adaptation to changing users' needs and country circumstances, it is recommended that the scope of the agricultural census be described in general terms in the primary legislation, thus leaving details for inclusion in the subsidiary legislation. This approach will provide the census agency with the desired flexibility in planning the operation and in including in the census of information pertinent to the time the census is taken, based on large user- producer consultations regarding the census scope, coverage, data content and dissemination of census results.

2.26 In the census legislation it should be specified who are the respondents (the types of enumeration units) and whether the census is to cover the whole country or whether certain regions are to be excluded - as may prove necessary in some countries with thinly populated areas or difficult to access. Exclusion may be complete or certain census operations postponed until a later date. Certain regions of a country may be enumerated at different times of the year because of seasonal and agricultural conditions. When conducting a widened agricultural census (including

non-agricultural production households, holdings engaged in forestry, fishery and aquaculture activities) it is important that the census coverage is not restricted by the primary legislation only to agricultural producers.

Responsibility for the census

2.27 The census agency, which is the primary administrative body responsible for the census, should be indicated in the primary legislation. However, the legislation may call upon other central government agencies and local governments to participate in the census effort either with a coordinating function or by providing assistance or personnel. In these instances, it is advisable to make clear in the legislation that the operation is in accordance with the plans drawn up by the census agency in order to prevent cooperating agencies or local governments from independently introducing innovations for their own purposes, which could jeopardize the quality of census works and disrupt the timetable of operations.

Frequency of the census and time reference

2.28 Agricultural censuses are usually undertaken every ten years. In some countries where the ten-year interval is too long, more frequent censuses are carried out (e.g. with five-years interval). The periodicity of the census is usually determined in the primary legislation. Such an enactment would establish the legislative or budgetary authority for the census to be undertaken at regular intervals and for the provision of the necessary funds. Census operations can therefore be planned well ahead, or the ad hoc census body can be organized well before the scheduled date. On the other hand, the timing established by the primary legislation will not be mandatory when funding cannot be found. In any case, the periodicity indicated is intended to provide a general guideline.

2.29 An agricultural census may consider as time reference either a situation at a given date or a certain time span, the distinction depending upon the specific census items. As specified in Volume 1 of the WCA 2020 the census has two main reference periods depending upon the specific subjects of enquiry – namely, the census reference year (for flow items) and the census reference day (for inventory items) (see paragraphs 6.33 - 6.34). The primary census legislation, when designed for a specific census, may specify the census reference period. However, in many cases this is made in the secondary legislation (is delegated to the census executing authority). In some countries, according to the legislation, the conduct of agricultural censuses is synchronised with population censuses. For instance, synchronizing the agricultural census with the population census may allow the census agency to: make use of the information needed for building-up a census frame; share ICT and other equipment, cartographic material, staff; have common and synchronised communication and publicity strategy, logistics plans, contributing in such a way to strengthening institution's capacity and to a more efficient conduct of both census operations.

Administrative and financial provisions

2.30 The primary legislation should grant the census agency full executive authority over the organization of the census. In countries where the appointment of personnel is governed by specific civil service regulations, such authority may include powers to recruit and appoint temporary field personnel without the usual strict procedural or documentary requirements attached to ordinary appointments. The primary legislation should also vest full authority over the budget in the census agency.

2.31 Usually, the funds for a census are allocated in the relevant section of the national budget, in a sufficient amount, recommended by the census agency. Although, due to financial constraints, funding of agricultural census in many developing countries depend on mobilisation of external funds, national authorities should secure a significant part of the census costs to be covered from the national budget. In such countries more effort might be needed in aligning the legislation with indication of sources of funding, particularly the national budget.

2.32 The ideal census budget assigns the agency authority to reallocate resources when unforeseen difficulties arise, especially during the enumeration and the final stages. When other agencies are called upon to participate in the census operation, the relevant enactment may also indicate whether their expenses are to be borne by the respective agencies themselves or additional budget for census activities performed by such agencies are to be allocated.

2.33 Provision may have to be made, in either the primary or the secondary legislation, for authorizing the use of simplified administrative procedures, including the appropriate delegations of authority for the procurement of equipment and supplies and the recruitment of personnel during the operational phase of the census¹⁵.

Rights and obligations of the public with respect to the census

2.34 The law should mention the rights of the respondents and their obligation to participate in the agricultural census, and to provide accurate information. Normally the text prescribes the freedom of access to holdings for the enumerators when visiting them or invites respondents to give information in another form, e.g. by mail or directly at the data collection centres.

2.35 The taking of an agricultural census is considered a task of national interest in which all concerned civil and juridical persons are expected to collaborate. The legal obligation to cooperate in the census and provide accurate information is a common denominator of most countries' census legislation. This is normally provided for in the primary legislation, and will very likely be reiterated and treated in detail (including the provision of penalties for non-cooperation) in subsidiary legislation.

2.36 One of the most important conditions for the success of a census is the strict confidential treatment of the information provided by the respondents and the assurance that such information will be used only for statistical purposes. Without a guarantee of confidential treatment of responses, respondents may refuse to answer statistical questionnaires for fear of the possible consequences, for example on their taxation¹⁶ (see also paragraphs [2.39-2.41](#)).

2.37 In order to enforce the legal provision that individual census data (along with data from other statistical collections) will be used only for statistical purposes, in some countries¹⁷ the legislation stipulates that such information shall not be used as evidence in any court or for any other purpose other than statistical enquiries. In such a way legislation provides "immunity" to respondents against legal or administrative actions based upon census data.

2.38 Active participation of all concerned persons and institutions involved in census operations, apart from their "civic responsibility", is essential. Refusal to give information, or the giving of false or incomplete information, will place the entire census operation in jeopardy. For this reason refusal to be interviewed or to furnish the data needed, giving false or incomplete information or delaying the submission of census questionnaires is a punishable act in many countries (see paragraphs [2.48-2.49](#)).

2.39 Holders might be sceptical of statistics and the usefulness of the agricultural census; they may consider the census to be interference in their personal affairs and a prelude to an increase in taxes. For this reason, as part of the publicity campaign, the legal status of the census should be publicized so that the respondents are aware of the census objectives and that the information they supply will be treated in confidence, and that they are required to give the information asked

¹⁵ UN (2015). Principle and recommendations for population and housing censuses, revision 3. New York (paragraph 2.70, p.49).

¹⁶ Eurostat (2012). Methodologies & Working papers: Guide to Statistics in European Commission Development Co-operation: Luxembourg: Publications Office of the European Union, 2012_KS-RA-11-028-EN.PDF.pdf, p.68

¹⁷ Such countries as Estonia, Finland, Moldova, Panama, Philippines, Romania, United Kingdom, etc.

of them. It is not sufficient to print excerpts from the legislation on the questionnaire so that only some people read it at the time of the census. The census legislation should be made known well in advance through the media as well as through publication in the official gazette, and should at least be made available to the farmers' associations. In multilingual countries, translation of census laws (at least of the relevant parts of them for respondents) into main local languages will contribute to a better public awareness, as well as to improve the cooperation and the participation of the target population in census activities.

Confidentiality of information

2.40 Confidentiality refers to the legislative measures or other formal provision which prevent unauthorised disclosure of census data that identify a household/holding either directly or indirectly. It also refers to the procedures in place to prevent disclosure of confidential data, including rules applying to census staff, aggregation rules when disseminating census data, provision of unit records, etc.¹⁸

2.41 The confidentiality of the individual information should be strongly and clearly established in the national legislation, commonly in the primary legislation. In many countries a reference to confidentiality is made on each census questionnaire to remind the enumerator and to reassure the respondent as to the protection and confidentiality of the individual information.

2.42 To secure the handling of data and strengthen the trust from concerned holders, in some countries several legal acts are in place, such as Statistics Law, Privacy Act and Data Act. These legal acts regulate how data can be transferred, handled and delivered inside the census agency and between the agency and other organizations and users¹⁹.

Identification, obligations and rights of enumerators and other census staff

2.43 The identification, protection and obligations of enumerators and other census personnel are additional matters for which the legislation (commonly the primary legislation) should prescribe. Proper identification documents for the field staff are essential to ensure the public trust in census personnel and the obligation of the respondent to cooperate.

2.44 As a matter of policy, identification documents should be shown to the respondents to protect the public from impostors. At the same time, adequate protection should be provided to the enumerators in the form of insurance against accidents, in addition to what they may receive under the workmen's compensation laws.

2.45 Establishing in the primary and/or subsidiary legislation the specific obligations upon the enumerators to record the responses faithfully and upon overall census personnel to ensure protection and confidentiality of individual census information can make them better aware of their functions and make it less likely that they will abuse or neglect them. This also will contribute to strengthening the trust from the respondents and to improve their cooperation during the census operation.

Access to administrative data sources (ADS)

In order to enable the access to administrative data sources for census purposes at holder level, e.g. for establishing the census frame or as a source for census data (see also Chapter 11), the census agency should have a clear legal mandate to collect relevant administrative data. In many countries, such a mandate is provided implicitly based on the statistics law. In countries where statistics or other laws do not make clear provision for this, the census agency's right of access to

¹⁸ OECD: Glossary of statistical terms. <https://stats.oecd.org/glossary/detail.asp?ID=4930>

¹⁹ UN (2015). Principle and recommendations for population and housing censuses, revision 3. New York

relevant administrative data sources for census purposes and related conditions (e.g. free access, data protection) should be included in the census law, if available.

2.46 An ideal state of affairs is one of reciprocity, where:

- ◆ The statistical and/or census legislation lays down the rights and conditions of access for statistical purposes, and
- ◆ The specific legislation that protects the owners of administrative sources recognizes as an exception the right of access to such data sources by the statistical/census agency²⁰.

Box 2.4 Country examples: Legal provisions on the access to administrative data sources

Netherlands: It has become government policy that, in order to reduce respondents' burden, the same data may only be collected once. This policy is also applied in the census, by combining data collection for statistical and administrative purposes.

The Act on Registration of personal data and the Statistics Netherlands Act protect census data on individual private or legal persons against illegal use, such as being published, sold, used or exchanged without permission of the persons involved. NSIR (the Executive Service of the Ministry of Economic Affairs, Agriculture and Innovation), as well as Statistics Netherlands and all personnel having access to the data have to comply with these Acts. Furthermore, Statistics Netherlands is not allowed to use census data for any other purpose than producing the statistics for which the data were intended and is not allowed to publish data in such a way that individuals or data on individuals may be identified.

Ireland: The Statistics Act, 1993 grants the Central Statistics Office (CSO) right of access to records of public authorities for statistical purposes (with a number of exceptions). Specifically under the Act the CSO may request any public authority to consult and co-operate with the CSO for the purpose of assessing the potential of the records of the authority as a source of statistical information and, where appropriate and practicable, developing its recording methods and systems for statistical purposes.

Census data dissemination

2.47 According to the UN Fundamental Principles of Official Statistics all organisations that are responsible for producing official statistics, including agriculture census data, must compile and disseminate them in an impartial manner.

2.48 Thus, the statistics law or/and the specific census legislation should clearly specify the obligation of census authority to ensure openness and transparency in the way the census results are disseminated. It is equally important that census agencies maintain professionalism, demonstrate neutrality and objectivity in the presentation and interpretation of census results.²¹

Sanctions

2.49 As mentioned above, the census agency is required to safeguard respondents' information. If the agency breaks this commitment, its personnel might be subject to certain sanctions (penalties). If respondents do not comply, they too might be subject to certain sanctions.²²

²⁰ UN (2003). Handbook of statistical organisation. Third edition: The operation and organisation of a statistical agency, p.40

²¹ UN (2015). Principle and recommendations for population and housing censuses, revision 3. New York (paragraph 3.237, p.131)

²² UN (2003). Handbook of statistical organisation. Third edition: The operation and organisation of a statistical agency,

2.50 Penalties are imposed mainly for two kinds of offenses²³:

- ◆ In the case of respondents, for refusal to be interviewed or to furnish the data needed, giving false or incomplete information or delaying the submission of census questionnaires,
- ◆ For violation of confidentiality on the part of census personnel and the authorities concerned.

Box 2.5 Country examples: Legal provisions on census data secrecy and sanctions

France: In accordance with the Statistical Confidentiality Act (No 51-711 of 7 June 1951), the data collected are used for statistical purposes only, and the interviewers and statisticians are bound by professional secrecy. In return, the law obliges farmers to give precise answers to the questions asked.

Failure to reply or a deliberately inaccurate response gives rise to court proceedings, and an administrative fine is imposed as the final penalty (<http://ec.europa.eu/eurostat/documents/749240/749313/FR++2010+FSS+NMR+ENG+updated+Oct+2016.pdf/ee32111a-4c74-407a-829b-b75fcd85a328> , p.4)

Italy: the Decree of Republic President n. 154 of 23 July 2010 establishes the rules of the execution of the 6th Agricultural Census (2010). Art. 27 “Obligations of the respondents” states the following:

1. All the units under art. 3 are obliged to provide the information requested by the questionnaire.
2. In case of refusal, administrative penalties under the art. 11 of the Legislative Decree n. 322/89 are applied. The amount of penalties constitutes from 200 to 2000 euro (http://ec.europa.eu/eurostat/documents/749240/749313/IT_NMR_FSS_2010_vers2.pdf/9f98a6b9-2b70-4b1e-b5d6-4d5744595f00, p.5).

More country examples (Burkina Faso: Punishment for using info for other purposes, etc.): [Link](#)

2.51 The Generic Law on Official Statistics, developed jointly by the UNECE, the European Free Trade Association and Eurostat provides recommendation and good practice guidance on establishment of an official statistics law and might be useful for countries which have not such a law, or consider its updating²⁴.

Country examples (of specific census legislations and other laws regulating the implementation of the agricultural census) –Link

Suggested reading:

Eurostat (2012). Methodologies & Working papers: Guide to Statistics in European Commission Development Co-operation: Luxembourg: Publications Office of the European Union, 2012_KS-RA-11-028-EN.PDF.pdf: <http://ec.europa.eu/eurostat/documents/3859598/5923481/KS-RA-11-028-EN.PDF/311c1331-6936-4295-85c6-0e1d28a88039?version=1.0>

UN: Fundamental Principles of Official Statistics: <https://unstats.un.org/unsd/dnss/gp/fundprinciples.aspx>

p.38

²³ Such countries are: Argentina, Armenia, Australia, Austria, Belarus, Bangladesh, Belgium, Bulgaria, Burkina Faso, Canada, Chile, China, Costa Rica, Cook Island, Cyprus, France, Germany, Greece, Guatemala, Hungary, Jamaica, Japan, Iceland, Indonesia, Italy, Korea, Republic of, Lao PDR, Lesotho, Luxemburg, Moldova, Mongolia, Myanmar, Nepal, New Zealand, Nicaragua, Niue, Norway, Peru, Philippines, Poland, Portugal, Puerto Rico, Romania, Samoa, Serbia, South Africa, Sweden, Tanzania, Thailand, Togo, Uganda, Uruguay, USA, Zambia, etc.

UNECE (2016) Generic Law on Official Statistics for Eastern Europe, Caucasus and Central Asia: https://www.uncece.org/fileadmin/DAM/stats/publications/2016/ECECESSTAT20163_web.pdf

UN (2015). Principle and recommendations for population and housing censuses, revision 3. New York

Eurostat (2012). Methodologies & Working papers: Guide to Statistics in European Commission Development Co-operation: Luxembourg: Publications Office of the European Union, 2012_KS-RA-11-028-EN.PDF.pdf

UN (2003). Handbook of statistical organisation. Third edition: The operation and organisation of a statistical agency

UNECE (2016) Generic Law on Official Statistics for Eastern Europe, Caucasus and Central Asia:
https://www.unece.org/fileadmin/DAM/stats/publications/2016/ECECESSTAT20163_web.pdf

DRAFT

CHAPTER 3 INSTITUTIONAL FRAMEWORK

The main responsibility for the adequate preparation and implementation of the agricultural census normally rests with the census agency and this is commonly specified in the primary census legislation. However, the success depends on the support and assistance of other ministries and public agencies at various stages of the work. In these circumstances, establishing coordination between the various agencies is paramount. However, this is sometimes difficult because each agency may have a different mandate regarding the purpose, scope and timing of its work.

There are well-documented and proven advantages in having a permanent office (a census office) within the census agency in charge of agricultural census activities established within the national statistical system. Such an office assures continuity in census work and is the principal center for the formulation of the programme and the initiation of preparatory work for the next census.

Along with this, an inter-ministerial Steering Committee is considered essential to guide and coordinate all census activities. Other national and sub national bodies could be useful too, especially in planning and preparation of a census. Such formal structures may be composed of representatives of central and sub national public agencies, farmers associations, other agriculture and food organizations, non-governmental organizations, academia, etc.

This section details various issues related to the appropriate institutional framework for the organization of an agricultural census.

Ensuring political support for conducting an agricultural census

3.1 Like in a population census, in an agricultural census the combination of three factors makes managing a census challenging: first, it is one of the largest statistical activities in a country; second, it is conducted only periodically, generally with a frequency of 10 years; and third, it involves the mobilization of important financial, human and other resources during a short period. Managing an agricultural census entails working in a multi-institutional environment, involving many people with little or even no experience in census taking. In addition, it entails long project timelines within which there may be turnover of key personnel and also a geographic spread that covers the entire country. It requires the cooperation and collaboration of a range of organizations, both public and private. Therefore, a strong political support and establishing an efficient coordination between the census agency and other agencies is essential.

3.2 As discussed in Chapter 2 the census executing authority (or “census agency”) varies considerably from country to country and should be clearly specified in the primary census legislation. Commonly such an administrative authority and responsibility to conduct agricultural censuses is delegated to a specific government institution, such as:

- ◆ National Statistics Office²⁵ (NSO)
- ◆ Ministry of Agriculture (MoA) or other executive branch of the government charged with agriculture²⁶.

²⁵ In countries such as Argentina, Albania, Armenia, Australia, Austria, Bangladesh, Brazil, Cambodia, Canada, Chile, Cyprus, Czech Republic, Denmark, Estonia, Germany, Greece, Hungary, Jamaica, Iceland, Indonesia, Ireland, Latvia, Lithuania, Macedonia, Malta, Moldova, Mozambique, Netherlands, Russia, Kirghizstan, Malta, Mexico, Mongolia, Montenegro, Nepal, Norway, Panama, Poland, Portugal, Peru, Romania, Serbia, Slovenia, Spain, Sweden, Tanzania, Thailand, Uganda, United Kingdom, Viet Nam, etc.

3.3 The responsible organization will differ from country to country depending on whether the Ministry of Agriculture, as the main user of agricultural statistics, has a full-fledged division or department of statistics or the National Statistics Office is not only a coordinating body but also charged with the responsibility of organizing and conducting agricultural censuses and surveys.

3.4 In a number of countries, the census implementation is under the joined responsibility of NSO and MoA and possibly may involve other ministries and agencies, and/or local governments²⁷.

3.5 Where various agencies are called upon to participate in the census effort, coordinating boards would be necessary for an efficient census organisation. Commonly for conducting an agricultural census, apart from the census office, which, within the census agency, is in charge of the technical census work, national and sub national commissions or committees, or other boards are established. Such bodies may be composed of representatives of relevant governmental departments, and of non-governmental users of the census data. The latter should represent well the most relevant user segments of society, particularly those involved in policy-oriented analysis of census results and analytical studies of the agricultural and rural development of the country.

3.6 The consultations, carried out through these formal structures is an efficient and transparent means to meet in the best way users' expectations. Broad based participation of stakeholders and users in census planning and implementation ensures the relevance and credibility of census results. It is important, however, that advisory and promotional functions of such boards be clearly defined and that the final responsibility for planning and execution rest with the census agency.

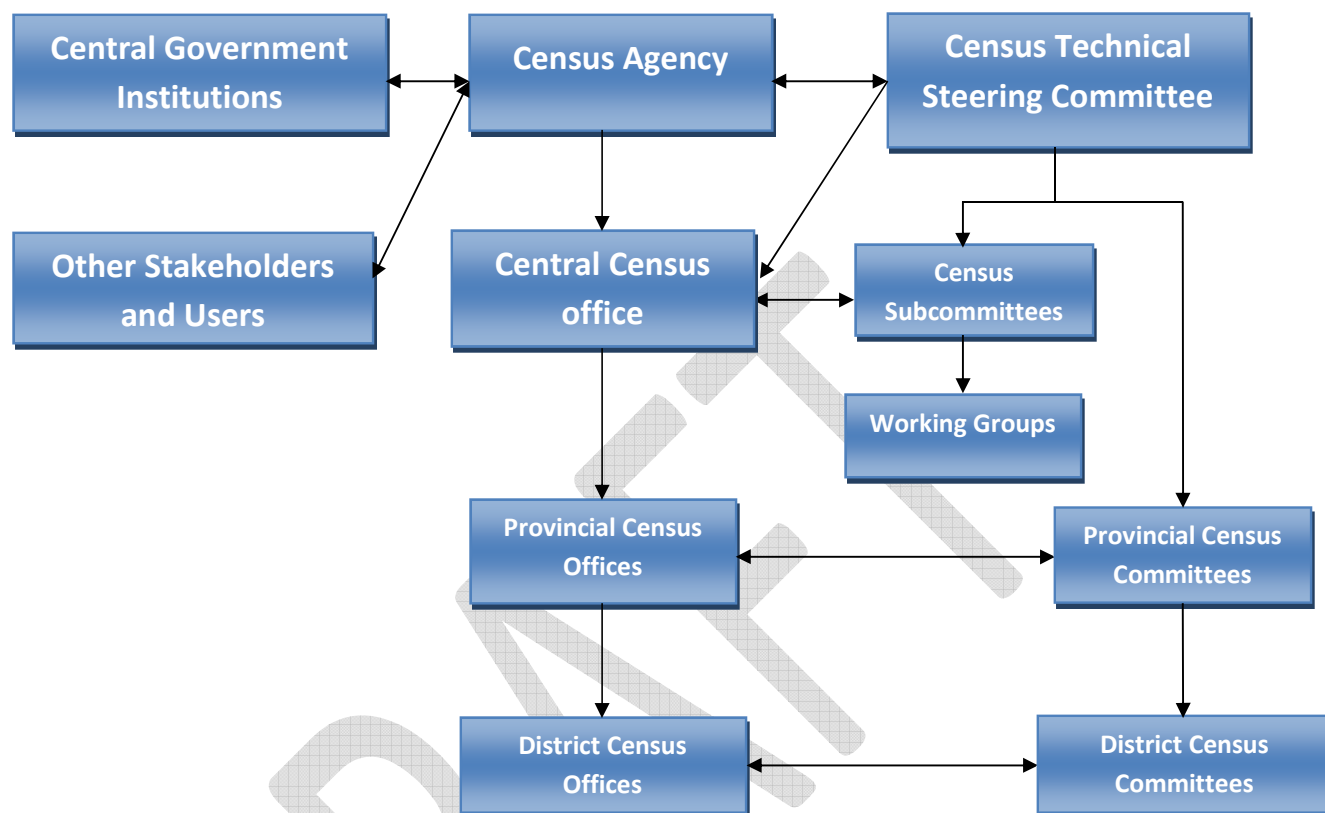
3.7 Historical, cultural and political factors of each country lead to diverse administrative structures conducting agricultural census. Hence, there cannot be a single approach to the development of census institutional framework. An example of structure of a census organization is illustrated in Figure 3.1. It can be adapted by countries to suit their own particular circumstances.

3.8 An overview of the main formal structures usually established in the country for census undertaking, i.e. of the Central Census Office, Provincial Census Offices, Steering Committee and other census bodies at the national and sub national levels (such as subcommittees and provincial committees) are discussed below.

²⁶ In countries such as Bulgaria, Burkina Faso, Finland, France, Guyana, Haiti, Japan, Myanmar, Paraguay, Suriname, Togo, Uruguay, USA, Venezuela, etc.

²⁷ In countries such as Antigua and Barbuda, Belgium, El Salvador, Gambia, Niger, the Netherlands, Seychelles, India, etc.

Figure 3.1 Example of structure of a census organization



Census office

3.9 The primary and chief responsibility for planning, organizing, conducting and supervising the agricultural census operations, including developing the methodology and all technical documentation, data collection, data processing, analysis, archiving and dissemination of census results normally rests with a single government structure – the census office. The census office commonly is established within the census agency on a permanent basis or just for the period of preparation to the census until its finalisation.

3.10 There are well documented and proven advantages in having a permanent office in charge with agricultural census activities established within the national statistical system. Such an office assures continuity in census work and is the principal centre for the formulation of the programme and the initiation of preparatory work for the next census. Its permanence permits the development of specialized and experienced personnel and the maintenance of statistical and cartographic information, including cross-cutting issues such as information technology, essential for planning the census.²⁸

²⁸ UN (2015). Principle and recommendations for population and housing censuses, revision 3. New York. (paragraph 2.92, 2.94, p.53)

3.11 Success depends on the support and assistance of other departments of the census agency and relevant ministries and other government agencies at various stages of the work. This cooperation is particularly important for successful census planning, preparation and conduct, including activities such as design of the methodology and questionnaires, building census frames, mapping and delineation of enumeration areas, recruitment, training supervisors and enumerators, data collection, processing, archiving and dissemination.

3.12 Countries need to pay special attention to continuity of knowledge and skills from one census to the next, since the intervening gap, which is usually a whole decade, is likely to cause loss of institutional memory and attrition of qualified personnel. Comprehensive documentation of census activities while they are being carried out, training of younger personnel to create a pool of knowledgeable and experienced persons by the time the next census comes contribute to the sustainable capacity of the census office. In addition, the migration of the census of agriculture towards common collection, metadata, processing, analytical and dissemination platforms used for other programs in the census agency might favor mobility of people working on other programs. They could be easily deployed on the census program when needed with minimal training.

3.13 The number of census personnel is adjusted to meet the needs at different stages of census operation. Subsequent to the enumeration, the census organization is usually readjusted to meet the needs involved in processing, evaluating, analysing and publishing the results and to provide the continuity desirable for promoting the use of census products.

3.14 The role of the census coordinator, who is usually the head of the census office, is important to ensure a successful census programme that delivers results for the users. The census coordinator is the person responsible for the census within the census agency. The main requirements to and responsibilities of the census coordinator, as well as of the other census staff are described in **Chapter 15**.

3.15 Often the census office consists of the central office and provincial offices (census offices at sub national level), as discussed below.

Central census office

3.16 The central census office (CCO), i.e. the department at the national headquarters responsible for the organization of the agricultural census, can be the statistics department (or division) in the Ministry of Agriculture or a relevant department/division in the National Statistics Office. The CCO will seek the support and assistance of other departments, first of all within the census agency, either in organizing the field work and enlisting the cooperation of the staff or in developing plans and procedures, concepts, definitions and classifications.

3.17 This support and assistance, especially outside the census agency can be secured by the technical steering committee (or coordinating board) at the national level with representatives of all departments concerned with the census preparation activities, field organization and use of agricultural data. One of the major functions of the CCO is to coordinate the activities of the staff in the field and to solve the practical difficulties encountered during the census operations. To solve field problems quickly and effectively, it is also necessary to set up census offices at the sub national level, as well as census committees at provincial and district levels.

3.18 At the census preparation stage, the census office will need to be expanded to form the nucleus of the full census organization, which must be capable of directing the field organization during the preparatory work as well as during the enumeration and processing.

3.19 To ensure that there is the greatest possible scope for the coordination of activities between the various units and teams within the CCO, it is recommended that these be located in the same premises. If this is not possible for some reason, allowance must be made for sufficient communications and face-to face meetings between members of the various census units and teams.

3.20 As the development work progresses, it should be expected that the relevant units and teams will increase in size, as the level of detail involved in their work increases.

Provincial²⁹ census offices

3.21 A large-scale operation such as an agricultural census is difficult to control and guide effectively from a single central office at the national headquarters. The problems and difficulties of the field staff cannot be expeditiously communicated and timely solutions obtained. It is also difficult for a central office to make adequate arrangements for transport of field staff in distant places. The training of the field staff and supervision of their work from a central office cannot be adequate and effective. Supply of equipment and census material, provision of necessary facilities and amenities, etc., to field staff from a central office will be slow. These problems are more difficult to handle if the country is large and transportation and communication facilities are limited.

3.22 In order to provide immediate supervision in each area, field offices at various levels, such as at the provincial and district levels, are needed for the later part of the preparatory work, including field organisation, staff recruitment and training, as well as for the field data collection. Supervisory personnel in such offices should be persons who, being familiar with the particular area and the local language, are able to deal with local problems. This does not mean, however, that all supervisory positions need necessarily to be filled by persons from the area. Personnel may be transferred from the central office or from other areas as the need arises. Prior training of all such personnel is necessary, so that they have a working knowledge of all aspects of the current census programme.³⁰

3.23 If the department responsible for the census organization already has provincial and district offices for normal statistical work, these offices should be strengthened to deal with the increased work during the agricultural census. The provincial offices for census purposes should be located near the structures of the census agency and other provincial government offices.

3.24 The provincial and district offices can serve as the secretariat and coordinating body for the regional census committees. These offices put the problems and difficulties faced in the field before the provincial or district authorities represented on the committees and obtain solutions, support and assistance. To enlist the support and cooperation of community/village leaders, these offices can organize local meetings in which the administrators and officials of local administration can assist in educating people on the objectives and scope of the census, its need and importance, its role in planning the country's agricultural development and the need for the people's support and cooperation in achieving the desired results of the operation. Any concerns which might exist about operations can be addressed effectively by the provincial or district authorities.

3.25 The provincial and district offices can pull together the field and supervisory staff of different departments for statistical operations in the province or district and coordinate their activities. Instances of lack of cooperation on the part of any member of the field staff can be brought to the attention of concerned departments for prompt solution at the local level. These offices can also

²⁹ In this publication, the names province and district are used to indicate 1st and 2nd level country sub-division units respectively.

³⁰ UN (2015). Principle and recommendations for population and housing censuses, revision 3. New York. paragraph 2.93,

assess day-to-day transport requirements and pool transport facilities for census operations in the province or district.

3.26 The provincial offices can organize intensive training courses of small groups of enumerators and their supervisors in the province with reference to specific local conditions and problems. The enumerators and supervisors in a province can be gathered more conveniently at a provincial office to discuss problems that might appear common to these staff. Some trained enumerators can be kept in reserve at provincial level to fill vacancies arising from resignations, sickness, etc.

3.27 The supervision of fieldwork, the prompt resolution of mistakes, the ability to keep staff working on location, to monitor and gather completed questionnaires from the enumerators (when PAPI method is used) and to complete review of questionnaires and their evaluation in consultation with enumerators can best be organized from a provincial office. Transfer of enumerators from areas where work has been completed to other areas where the work is lagging behind or is not satisfactory can be assessed and resolved promptly from a provincial office.

The census technical steering committee

3.28 The establishment of a **Technical Steering Committee, TSC** (or coordinating board) is essential for the successful implementation of the census. This committee (or board) may be known as the "Agricultural Census Steering Committee" or just "Agricultural Census Committee". It has to be established well ahead of time, invested with the necessary authority, provided with material support and composed of high-level personnel. It should be an organ created by the regulatory text establishing the census. For a census conducted over a 10-year cycle, it should start functioning at least two years ahead of the actual operations of the field work of the census and cease to function after the dissemination of the final census reports and archiving of the census data. For countries conducting the census with greater frequency (e.g. every 5 year), the TSC should be permanently in place.

3.29 The committee should consist of representatives of major stakeholders, from all important national government agencies directly or indirectly concerned with census taking and users of census results, as well as non-governmental organizations interested in the census, such as:

- ◆ Census agency entrusted with the task of carrying out the census;
- ◆ National Statistics Office (if other than the census agency);
- ◆ Ministry responsible for agriculture; if in a country there are several ministries which are in charge with agriculture (e.g. Ministry of Crop Production and Ministry of Livestock) all of them should be represented in the committee);
- ◆ Ministry(ies) for cooperation and district administrations, as well as for rural development;
- ◆ Ministry of Finance;
- ◆ Farmers' organizations;
- ◆ Industry and trade associations particularly concerned with agricultural products;
- ◆ Owners of administrative data sources relevant for census purposes (e.g. land cadastre agency, real estate agency, etc.);
- ◆ Institutions with research programmes on agriculture, research institutions;
- ◆ Representatives of the private sector, etc.

3.30 It is essential that the committee members be high-ranking officials who are able to provide high-level specialist advice, are in a position to take decisions on behalf of the institutions (organisations) they represent and make recommendations to the census office.

3.31 The committee's chairperson could be the head of the census agency or another person appointed by him/her. The national agricultural census coordinator could act as secretary to facilitate coordination among members.

3.32 The composition and the number of members will vary depending on the government structure of the country, level of the integration of agricultural statistics and degree of centralisation of official statistics, experience of the country in conducting agricultural censuses, scope and coverage of the census, etc. However, care should be taken that the Committee is not so large as to become unmanageable. An example of the Agricultural Census Committee of the Republic of Congo is given in **Box 3.1**.

Main responsibilities and functions of the TSC

3.33 The main responsibilities and functions of the committee would depend on the particular purpose of its creation. Generally, the main responsibility would be the overall planning and direction of the census, subject to review by the census coordinator. It is expected that the committee would evaluate past censuses and study recommendations made to solve problems encountered. The committee would also liaise with other agencies involved in agriculture or which may be called upon to participate in the operation. The committee would endorse the census work plan, scope and coverage, main methodological principles, questionnaires, manuals, budgetary and personnel requirements, plans for the publicity campaign, logistical needs, pre-test and pilot censuses, post-enumeration survey plan. The most use of this committee should be made in the planning and preparation phases. Meetings should be held usually at least once every three months and should follow a well-defined agenda. Members should be given sufficient time to study the meeting documentation in advance.

3.34 The committee should be seen as a review body that provides advice to the census office, especially on strategic directions and issues, as well as a coordinating and supporting body which should contribute to a more efficient interagency cooperation.

3.35 The technical steering committee is only one of a number of formal mechanisms that managers of a census can utilize to gain access to levels of expertise and experience augmenting those of the team - that is the key role of such committees. They do not absolve the census managers from their responsibility to manage the operation. Other types of census boards are discussed below.

Box 3.1 Example of the Agricultural Census Technical Committee: Republic of Congo³¹

Main responsibilities:

- ◆ Preparing the meetings of the National Steering Committee of the General Census of Agriculture
- ◆ Approve the calendar of activities of the agricultural census
- ◆ Validate the methodological and technical documents
- ◆ Give a motivated opinion on the results of the general census of agriculture

Composition and leadership:

- ◆ Chairman: Director General of the National Statistics Institute
- ◆ Vice President : Director General of Agriculture
- ◆ Secretary : National Coordinator of the Agricultural Census
- ◆ Spoke person: Director of Research and Planning of the Ministry responsible for Fisheries

Members:

- ◆ Director General of Planning and Development
 - ◆ Director General of Animal Husbandry
 - ◆ Director General of Inland Fisheries
 - ◆ Director General of Marine Fisheries
 - ◆ Director General of Aquaculture
 - ◆ Director general of Forestry
 - ◆ General Manager of the Integration of Women Development
 - ◆ Director General of Youth
 - ◆ Director General of Lands
 - ◆ Director General of Domestic Trade
 - ◆ Director General of Small and Medium Enterprises;
 - ◆ Delegate General for scientific research
 - ◆ Attaché for Agriculture in the Office of the Head of State
 - ◆ Attaché to the Fishing Office of the Head of State
 - ◆ Director of the Coordination and Harmonization of Statistics at the National Statistics Institute
 - ◆ Director of Research and Planning in the Ministry of Agriculture
 - ◆ Director of Research and Planning in the Ministry in charge of Forestry
-

³¹ Source: Decree of the President of the Republic of Congo on the organization of the general agricultural census, November, 2013

More Country examples on the composition, main responsibilities and functions of the census technical steering committee: [LINK to country examples](#)

Other committees and boards

High-level steering committee

3.36 The TSC described above is mainly a technical committee, aimed at coordination of technical aspects of census preparation and implementation. However, in some countries, along with the TSC, a National High-level Steering Committee (NSC) is also established. The latter is usually chaired by a high-ranking official in the government and its members are high level representatives from ministries and other public agencies, as well as from non-governmental organisations, businesses and academia.

3.37 Its main task is to provide support to the census agency in setting up a good collaboration with relevant ministries and public agencies at the sub national level to get their necessary support and necessary human, financial, technical and other resources for the adequate preparation and conduct of census operations. Another important task of the NSC could be to ensure a large public support through a promotion of a wide census publicity campaign.

3.38 Experience shows the usefulness of such a committee especially in countries with little experience in agricultural census taking, a decentralised agricultural statistics system or/and lacking a well-established coordination mechanism of agricultural statistics survey programme.

Sub-committees, advisory and working groups

3.39 Due to the broad functions and activities of the TSC and NSC, it may be appropriate to establish sub-committees and working groups. These may be created, each under the area of coordination or supervision of a member of the steering committee. Sub-committees can be formed to advise on specific technical matters such as concepts and definitions, methodological aspects, questionnaire design, data processing, etc., or on more general aspects of the census operation such as communications, transportation, logistics, recruitment, training, publicity, data dissemination, etc. These sub-committees would normally consist of a small group of subject matter specialists and would report on a regular basis to the steering committee.

Advisory boards

3.40 In some countries, the formal systems adopted by the census agency include advisory boards which will advise the census office on technical aspects of census operation. The members of such boards could be experts on agriculture, agricultural statistics, sample design, information technology, representatives of important users segments, such as those involved in analytical studies of the agricultural and rural development of the country, etc.

3.41 Again, the most use should be made of the above structures in the planning and preparation phases and not in the operational phases. This is because their main role is to provide advice on strategic issues or particular technical issues. It is unlikely that such boards will be able to respond quickly enough to resolve issues of detail that may arise during the brief and intense operational stages of the census³².

3.42 Depending on national circumstances, countries may have in place various combinations of the above mentioned census bodies (e.g. a NSC, a TSC and sub-committees or working groups), and may have other governance structures, including those dealing with very specific tasks (see Chapters 4 and 19). As a common practice, census agencies make also use of the established governance structures to monitor and manage census implementation (like National Statistics Board, management boards, certification committee, change management committee, etc.)

³² UN (2016). Handbook on the Management of Population and Housing Censuses (draft, rev.3), paragraph 2.116

Provincial committees

3.43 To solve field problems quickly and effectively, especially in large countries, it may be necessary to establish provincial census committees in broad administrative divisions. The main functions of such provincial committees would be to coordinate the activities of different institutions contributing to census implementation at the provincial level. They could also be asked by the census agency to make recommendations for items specific to the province to be included in census questionnaires and to advise on provincial tabulations.

3.44 The activity of provincial committees would normally be coordinated by the steering committee (TSC or NSC) and should be carried out in close cooperation with the provincial census office. Usually the head of provincial census office act as a secretary of a provincial committee. In some countries, census committees are also set up at district and at a lower administrative level. The important thing is to ensure good cooperation of such committees with the similar structures at the upper administrative level and with census office.

Country examples on the composition, main responsibilities and functions of the High-level steering committee and other committees and boards: [Links](#)

Suggested reading:

- UN: Fundamental Principles of Official Statistics: <https://unstats.un.org/unsd/dnss/gp/fundprinciples.aspx>
- UN (2015). Principle and recommendations for population and housing censuses, revision 3. New York
- Eurostat (2012). Methodologies & Working papers: Guide to Statistics in European Commission Development Co-operation: Luxembourg: Publications Office of the European Union, 2012_KS-RA-11-028-EN.PDF.pdf
- UN (2016). Handbook on the Management of Population and Housing Censuses (draft, rev.3),
- UN (2003). Handbook of statistical organisation. Third edition: The operation and organisation of a statistical agency
- UNECE (2016) Generic Law on Official Statistics for Eastern Europe, Caucasus and Central Asia: https://www.unece.org/fileadmin/DAM/stats/publications/2016/ECECESSTAT20163_web.pdf

CHAPTER 4 PLANNING AND BUDGETING

A census is one of the most complicated and extensive statistical activities, consisting of a complex series of interrelated processes. To ensure that the diverse census' operations occur in a proper sequence and in a timely manner, the entire census and its various component steps must be planned carefully in advance.

The implementation of the census of agriculture is also a resource-intensive operation for countries and there is growing pressure on national statistical offices to use the most cost effective strategies to collect data. The aim of the planning process is to ensure not only that each phase is properly resourced and organized but also that the output of each phase is of sufficient quality for all subsequent phases and that all dependencies between the different phases are identified. The level of complexity of the planned census modality should be carefully considered. For instance, when conducting modular census or using the integrated census and survey modality, planning and budgeting should cover an extended census programme, which includes the core census and all supplementary or rotating modules which would cover a period of up to 10 years.

Inadequate planning and/or underestimating the financial requirements are the basic reasons for serious problems in census operations. It is very important for the census managers to be aware of the time and resource requirements for this operation and realistic estimates when preparing the work plan and the budget. Time is an essential dimension that should never be neglected and even for a small census, at least two – three years is required from the initial preparatory and planning work to the dissemination of the final census results.

Introduction

4.1 The agricultural census along with the population and housing census are among the most extensive, complex and expensive statistical operations, consisting of a complex series of interrelated activities. Census operations are massive in scale and must be carried out in a uniform manner in all parts of the country. The planning and preparation for each new census round has to take into account the changes after the previous census operation in: field conditions; census methodology; technological innovations; user data requirements; changes in personnel; changes in societal conditions, etc. Therefore careful planning is critically important to a successful census, to ensure both that the extensive human and material resources are mobilized for the census, are effectively and efficiently used and that its very tight time schedules and massive logistic requirements are met.

4.2 The censuses do not follow a uniform pattern but there are certain major elements that must be taken into account. The undertaking of a census is usually regarded as a single project comprising a series of project phases and steps. In general, census operations can be divided into five main phases:

- ◆ preparatory work and testing,
- ◆ enumeration,
- ◆ data processing and building of databases,
- ◆ evaluation of the results,
- ◆ analysis, dissemination of census results and archiving.

4.3 The steps in developing the census of agriculture are listed in **Chapter 1, Box 1.1.**

4.4 Each phase is further broken down into appropriate activities and similarly each activity is broken down into tasks. However, given the size and complexity of the census, it can be divided

into a series of related projects that are dependent on one another, for example mapping and data processing can be considered as a sub-project considering their specialized nature of work in terms of the required skills, technology and methodology used.

4.5 Census agencies should ensure cost-effectiveness of the census from the very beginning of the planning process when choosing the most appropriate census method and technology. Planning the census as inexpensively as possible without compromising the quality of results requires carrying out cost-benefit analysis by estimating the strengths and weaknesses of alternative approaches regarding the methods and technologies which satisfy the objectives of the census. Based on such kind of analysis, it would be possible to determine options that provide the best approach to satisfy the objectives of the census for ensuring its cost-effectiveness. (see Chapter 1)

4.6 In planning the agricultural census, countries should be realistic about what can be done within available budgets and staff resources, and ensure that what is done is done well. In countries with limited statistical capacity and experience, technical assistance may bring the required expertise through projects funded by international community. Technical assistance in preparing and implementing agricultural census constitutes an important dimension of the collaboration of FAO with member countries requesting such support.

4.7 This section deals with the basic activities which should follow the decision to conduct an agricultural census. These are:

- ◆ work planning
- ◆ budget planning
- ◆ procedures to monitor the progress of census operations, and to control expenditure.

Work plan

4.8 An indispensable element in planning of a census is a work plan (timetable) indicating the sequence and estimated duration of each of the component operations of the census. At the early stages of census planning, a provisional work plan of selected milestones should be prepared as an overall framework for the census. A good starting point would be to look at the previous census work plan, or (if this is not the case) to similar operations (like economic or population and housing censuses). The time dedicated to each task in the past should be looked at and adjusted for known changes and new working assumptions for the upcoming census. The provisional work plan should be shared with stakeholders in advance for advice and support. It should be revised and made more detailed as planning proceeds, with the aim of establishing final dates as soon as practicable.

4.9 The census work plan is usually presented as a chart (see example in Table 4.1) identifying all the key census activities grouped into census phases or steps. The activities can then be further broken down into tasks to establish resource estimates, and responsibilities and confirm dependencies and timing of interrelated tasks.

4.10 Each phase and activity would have someone responsible for it. The management needs also to decide on the level of detail of the reports needed for various census bodies (steering committees, technical committees, etc.)

4.11 Time in the work plan is usually shown in months or quarters on the horizontal axes. More detailed plans could be presented also in weeks. Each row refers to a phase/step or to a key activity with a bar showing when it is active. The comparison between bars demonstrates obvious relations between phases/steps and between activities in time. For purposes of control, many activities that in fact overlap are shown separately in the work plan. Some information may be added to indicate possible flexibility of the relation. A well-prepared work plan should show, for instance, that

enumeration will start after questionnaires are available (printed and distributed to enumerators when PAPI is used) or after mobile devices are distributed and ready to use by the field staff (when CAPI is used).

4.12 Given the great number of specific activities, it is often practical to develop a general work plan and a detailed plan. The general work plan usually is broken down into broad subject matter areas, such as phases/steps and could include some key activities. An example of a general work plan is presented in Table 4.1.

Table 4.1 Example of General Work Plan³³

Activity	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Pre-enumeration																
Update the census legislation																
Form a Census Steering Committee																
User-producer workshop																
Tabulation plan																
Development of the census methodology and questionnaire design																
Manuals																
Pilot census																
Holding listing																
Printing census questionnaires and other materials																
Distribution of materials																
Recruitment of field staff																
Training																
Enumeration																
Field data collection																
Receipt of questionnaires and other materials from field staff and their delivery to the CCO																
Post-enumeration																
Post enumeration survey																
Preliminary results																
Data processing																
- data coding and data entry																
- editing and validation																
- tabulation																
Analysis & dissemination																
- thematic analyses																
- production (including printing) of census reports and of other																

³³ The example refers to a classical census conducted using PAPI method

Activity	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
dissemination products (CDs, maps, etc.) - national seminar and other public events to disseminate census results - on-line dissemination and dissemination surveys																
Archiving of census data and materials																

4.13 Detailed work plans show main census activities. Countries can prepare specific detailed plans for some census broad subject matter areas, such as for: publicity campaign; procurement; training; field enumeration; data processing; dissemination, etc. In this case, the census managers must ensure the necessary consistency of the specific plans and detailed work plans and of those with the general work plan. Some country examples regarding census work plans (including a detailed census publicity plan in Congo Republic) are presented at the end of the section.

4.14 The assessment of the length of each activity must rely on realistic information from the previous agricultural census or other similar operations (e.g. most recent population census). The results of the pilot census (see Chapter 17), carried out under conditions closely resembling the actual census, should also be used for adjusting the estimation of time and resource requirements.

4.15 In addition to a detailed plan in the form of chart, which serves as a checklist of operations, a work plan could be presented in the form of graph.

4.16 The importance of a well-thought work plan should not be underestimated. For this purpose, a network analysis can be useful. For large operations like censuses, such techniques as PERT (Program Evaluation and Review Technique) provides a systematic approach for realistic planning in line with target dates, indicating crucial tasks and contemplating alternative courses of action to be taken and highlighting inter-related resources and activities. Given the numerous tasks involved in the preparation and the conduct of a census of agriculture, the numerous stakeholders involved and the high number of complex interdependencies between the tasks, the use of a project management software (e.g. Gantt) is highly recommended.

4.17 Certain decisions, such as training of key office personnel and the activities of building up of the ICT census infrastructure should be taken at a very early stage. Therefore, the scheduling of the work plan should be such that ample time is allowed for all materials to arrive at their respective destinations in time.

4.18 Proper planning contributes to efficient procurement processes, and reduces the **risk** that may lead to major delays and even additional costs. It is critical that the work plan take into account financial flows of available resources, acquisition procedures, local conditions and transportation facilities. The time set for training and enumeration should be such that they are not interrupted.

4.19 It should also be kept in mind that agricultural activities depend on the agricultural season, so the enumeration period has to be planned accordingly to ensure the collection of reliable primary census data. When census is planned, it is desirable to avoid overlapping with other large scale societal events, such as elections or referendums.

4.20 Given the nature of the agricultural census, a delay which may not be so critical for a PHC or a sample survey, may result in losing a full year if the agricultural season is missed. In addition, this could have important budget implications, in particular due to increased fixed costs (such as the remuneration of the central and regional census office staff, rent, utilities costs) for the extended period of census implementation, or even variable costs (e.g. to update the lists of holdings, cartographic material, etc.). Therefore, it is not enough to have the commitment on the overall amount of resources, but also to ensure their availability in a timely manner.

4.21 The planning of the disbursement of funds for the remuneration of field staff in a timely manner is of particular importance. The financial rules and regulations in some countries (or even the rules of international partners when the census is implemented with their support) put a major constraint on census managers to pay salaries and allowances to field staff in time. In some countries with weak banking facilities (especially in rural areas), moving the money to the field is a big challenge. Also, payment of successive months might be conditioned by centralization of receipts for previous months signed by each field staff. Therefore, it is necessary at planning and budgeting stage to have an open discussion with financial services on the practical solutions and may be special provisions to be made for smooth implementation of field operations.

4.22 Simultaneously, or as part of a work plan, it is desirable to prepare information which will show the amount of work in physical terms for each specific activity. For example, the amount of work for the field enumeration can be measured by the number of holdings to be enumerated and the average time needed to access and enumerate a holding. For data entry, the amount of work can be measured in terms of the number of key strokes to be performed or questionnaires to be entered when PAPI is used. This information is indispensable for estimating the number of enumerators or number of data-entry equipment and operators required in order to accomplish the operation within the time scheduled in the work plan. In order to reduce the time frame, when practicable, shift work might be a good solution (for instance, data coding and entry performed in two shifts). This information is critical for census work planning and resource estimations. Furthermore, this information is valuable for monitoring the rate of accomplishment of specific activities, so that timely action can be taken in case delays are detected.

Census budget

4.23 Good planning is an essential prerequisite not only for achieving a cost-effective census but also securing comprehensive financial support for its funding. Methods and technologies that will be used in mapping, frame building, data collection, processing, etc. must be decided upon in advance as these have influence on costs.

4.24 Some countries have been forced to delay or even cancel a census because of funding constraints. Countries that have been able to secure partial funds or secure funds but at a late stage of their census preparation can be forced to compromise their data collection, data processing and dissemination of census results because of the shortage of funds. It is therefore recommended that all census operations including planning, cartography, enumeration, processing, post-enumeration survey, analysis and dissemination, be budgeted from the beginning and efforts made to mobilize the required funds.

The components and estimation of a census budget

4.25 From the work plan, a financial outline can be drawn up by assigning costs to specific activities. Here, two kind of costs should be distinguished:

I.Those for which the total cost derives directly from the product of a unit cost and a physical quantity. For instance, if q PCs for data entry and processing are required at p price each, the cost of purchasing PCs would be $q \times p$.

II.Those for which the cost, by its very nature, can only be either a flat rate (honorarium of an expert for instance) or a non-linear function of the quantity. In this latter category are the printing costs (questionnaires, manuals, publications, etc.), including the fixed costs and the variable costs where unit costs may decrease with quantity. That category includes also the prices for products (for instance ICT equipment, supplies), which could decrease dependent on the lot of items purchased.

4.26 The assessments of time and of cost (flat rate, fixed or variable) must be based on real prices for products and services on the market (for available items) and estimates obtained from previous experiences or by experts in the field. For instance, printing costs (when this service is contracted out) estimates from printing houses are clearly the best solution.

4.27 For planning the costs of a census, detailed and accurate data will be required on the following:

- ◆ number, period of employment and daily/monthly rate of census staff classified by function and manner of payment;
- ◆ type of equipment and material used for the census, manner of acquisition (in other words, purchase or rental) and cost;
- ◆ office space (surface measurement) for rent;
- ◆ type of services used for census operations (such as communication, mapping etc.).

4.28 All costing should be specifically identified and cover each of the three major census phases:

Pre-enumeration phase

The budget(financial outline) should consider estimates for:

- ◆ activities covering preparatory work, such as: frame preparation and obtaining/purchasing of required cartographic material, aerial ortho photographs, satellite imagery; development of the publicity strategy/programme and its implementation;
- ◆ number and employment period of each type of central census office personnel and the number and period of each type of training;
- ◆ ICT costs, including purchase and/or rental of equipment, software, system development and maintenance;
- ◆ purchase and/or rental of transport and other equipment and supplies, etc.;
- ◆ rental of offices for census staff;
- ◆ printing of questionnaires (when PAPI is used) and/or of other census documents and their distribution to the field staff;
- ◆ procurement of mobile devices (when CAPI is used), other kit and tools for field data collection, and their distribution to the field staff (for more details regarding field enumeration kit and tools the reader could refer to Chapter 17 “Organisation of field work”);
- ◆ other logistics, etc.

Enumeration phase

The costs for this major phase should reflect estimates for:

- ◆ recruitment and training of field staff;
- ◆ number and employment period of each type of census field staff and its number and period of each type of training;
- ◆ internet connection fees (especially when CAPI is used);
- ◆ quality control;

- ◆ shipment of completed questionnaires and other census documents to the respective provincial offices or central office;
- ◆ transportation cost , etc.

Post-enumeration period

The cost estimates should reflect estimates for:

- ◆ post-enumeration survey (PES);
- ◆ number and employment period of each type of census personnel involved in receiving and control of questionnaires and other census documents;
- ◆ all steps/stages of data processing (manual editing, data coding, entry, editing, validation and tabulation);
- ◆ analysis, evaluation, dissemination and archiving of census results (printed and electronic publications; dissemination events, etc.).

4.29 However, it should be taken into account, that:

- ◆ **Equipment requirements** and data processing needs have to be estimated in relation to the workload involved and anticipated expenditure involved in the purchase and hire of PCs or data entry equipment should be provided for in the appropriate fiscal year. Requirement of transport vehicles should also be estimated.
- ◆ **The logistics for census materials** will depend largely on whether the census uses paper or electronic questionnaire. If using a paper questionnaire, it will depend on whether the data will be manually keyed or scanned in. Whatever the method of data capture, there are other documents that will need to be prepared. It is important to prepare for the logistics for the census materials early in the census planning process, since it may take time for the materials to be printed or for mobile devices to be purchased and set up correctly.
- ◆ **Printing costs:** An agricultural census has a huge printing programme, including of census reports and census material, particularly when PAPI is used. The number of questionnaires to be printed runs from many thousands to millions in some countries, and considerable other material, such as the instructions manuals, has also to be printed. Special requirements to census questionnaires when scanning technology is going to be used should be taken into account (for more details see Chapter 14), which may considerably increase the printing costs.

4.30 Other costs are:

- ◆ **Travel expenses** need to be considered systematically, particularly in relation to the supervisory staff and mode of transport. These include mainly cost estimates of transportation and per diem of permanent employees. Census operations demand extensive travel for supervision and a shortage in funds required for travelling will adversely affect the quality of the census.
- ◆ **Office expenses and miscellaneous costs** may include hiring of office space and furniture, required equipment, raincoats and boots (if required) for enumerators, purchase of fuel, administrative and miscellaneous services, supplies and materials of office staff involved in the operation, accounting control forms and communication expenses, etc.

4.31 The budget should have built in some **contingency** allowance for inflation and unexpected expenses, such as higher transportation costs because of the increase of fuel prices or a larger number of enumeration units than initially estimated. In some cases a contingency pot could be even needed to cover the costs of the repeated field data collection in selected areas, where the quality of field work was inadequate. Along with it, a transparent procedure should be put in place to monitor and allocate the contingency pot. A good starting point, might be to allocate a percentage of the annual budget (say 3-5 per cent) each year for such contingency.

4.32 It is important that the persons at the administrative and supervisory levels who will be responsible for the execution of each operation participate in estimating the budget items. Such an organization of the work presupposes detailed advance planning and "cost-consciousness" on the part of those responsible for a census.

Some considerations regarding the preparation of the budget

4.33 In developing a census budget, sufficient resources need to be allocated to each of the phases. The resource need to be realistically assessed and quarantined from the impacts of other census operations. Whatever may have been the effectiveness of the enumeration and processing operations, the users will judge the census on the ability to deliver the data. Failure to deliver census data on time and in the way desired by users will reflect on the census programme as a whole.

4.34 There are various ways of estimating budgets:

- ◆ Budgets may be based on the allocations received for the previous agricultural census, brought up to current prices by adjusting for inflators for increased costs; deflators for efficiency gains (e.g. implementation of new technology); policy changes and population increases. Thus, budget figures from the previous census will have to be reviewed and modified, in particular due to changes in the census content, methods (e.g. of PAPI or CAPI, complete or sample enumeration, etc.) and coverage, quantitative and qualitative change in hardware and software, changes in wage rates and the costs of equipment, supplies, etc. all of which may affect the cost of the census. In most countries, several cost elements tend to increase (for example, wage rates) so that there is considerable pressure to achieve economies in other items of the census budget.
- ◆ Budgets may be based on the previous expenditure pattern, again adjusted as above, or
- ◆ Budgets may be estimated using costing models to establish the requirements for each of the census phases and activities with costs implication.

4.35 When experience from past agricultural censuses is not available, budget costs of the most recent population census and relevant on-going survey programmes should be analysed and could be considered when estimating costs for the census of agriculture. Where multiple modes of data collection and new technologies are being used for the first time, these must be tested for data quality and cost implications.

4.36 When experience from a previous census is not available, caution should be exercised in using the cost parameters from other countries. Differences in census content, organization and operations, as well as in cost accounting, can introduce serious incompatibilities into such country-to-country cost comparisons.³⁴ The FAO census website has some country examples that could be used as reference.

4.37 Once the budget has been established, funds should be allocated to particular financial years in the census cycle. This should then be broken down and itemized showing the various categories of expenditure. For censuses, as for any statistical operation, the budget should be prepared in accordance with the national rules and regulations. It should conform with the standard set forth by the authorities empowered to approve and appropriate the necessary funds. It should be detailed enough to permit easy examination and/or review and subsequent approval by officials concerned.

4.38 The field work, processing and dissemination of census data are usually the principal budget components of the census operation and are interlinked. In some countries, with poor infrastructure,

³⁴See United Nations Statistical Commission and Economic Commission for Europe, Conference of European Statisticians, *Costing Aspects of Population and Housing Censuses in Selected Countries in the UN/ECE Region*, Statistical Standards and Studies, No. 46 (United Nations publication, Sales No. E.96.II.E.15).

transportation cost may also be a major component, particularly in large countries with remote areas. The amount of field work will determine the amount of processing and dissemination. A balance has to be determined between the resources spent on these components. It has been the general experience that in a well-formulated agricultural census project about two-thirds of the total expenditure goes to planning and conducting the field work while one-third is spent on post enumeration activities (mainly data processing and dissemination).

4.39 With poor planning it often happens that a disproportionately large percentage of the total budget is spent on data collection and not enough funds are left for processing, tabulation analysis and dissemination, resulting in either a delay in or partial publishing of census results while searching for additional resources. It must be realized that field data collection is very expensive and if data remain unutilized because they are not processed and disseminated for any reason, it is a waste of national resources.

4.40 In large countries with socio-economic conditions varying from province to province, it may be helpful to prepare (for selected categories of expenditure) budget estimation for each province separately and then pool them together to arrive at a country estimate. For example, in large countries, transport and communication facilities may not exist uniformly in all the provinces and would need to be estimated first at the regional/local level. Separate estimates of travel and transport costs will have to be made for individual provinces.

4.41 Many national statistical offices may need to contract out some of the tasks during a census operation in the interest of efficiency and lack of in-house expertise. Commonly contracted out tasks include:

- ◆ Layout and printing of census questionnaires, other census material; reports and other printed dissemination products with census results
- ◆ Packing and delivery of census materials and equipment
- ◆ Census mapping
- ◆ Publicity campaign
- ◆ Systems development for data collection, processing and dissemination

4.42 However, not all census tasks are appropriate for outsourcing or contracting out and by doing so, will not bring the desired benefit of strengthening national capacities. As a general rule of thumb, core census activities (such as preparation of census frame, design and test of questionnaires and instruction manuals, census enumeration, analysis, preparation of census reports, dissemination of census results and archiving) should not be contracted out. If for some reason, some core activities need to be contracted out, then it is essential that the strategic control of such activities should firmly be with the census agency at all times.

4.43 Contracting out activities does not relieve census managers of their responsibility. If contractors fail to deliver quality products and services, in a timely manner, the census may fail. Statistical confidentiality and data protection should also be carefully considered when contracting out census activities. So managers have to build the capacity to ensure adequate and efficient outsourcing and work closely with contractors and monitor them regularly.

4.44 Presentation and adoption of the budget vary depending on the form or style adopted or practices followed by the country. A sample country budget is shown in Table 4.2 and some other country examples are presented at the end of the section.

Table 4.2 Example of the operational budget for the agricultural census (Cambodia,

Expenditure category	TOTAL US\$ ('000)
1. CENSUS PREPARATION	372
1.1 Users producers workshop	1
1.2 Training of the Census Office staff, including study tours	96
1.3 Cartography	2
1.4 Field equipment & vehicles	128
1.5 ICT equipment (PCs, etc.)	19
1.6 Software	13
1.7 Materials and supplies	5
1.8 Consultancies	185
1.9 Pilot census	2
1.10 Publicity	50
2. DATA COLLECTION	3,273
2.1 Training of field staff	116
2.2 Remuneration of field staff	3,157
3. DATA PROCESSING & ANALYSIS	286
3.1 Training	6
3.2 Remuneration of data entry and processing staff	280
4. PUBLICATION & DISSEMINATION	58
4.1. Dissemination workshops in Phnom Penh and provinces	13
4.2. Dissemination products (printed, CDs, website, atlas, etc.)	46
5. GENERAL COSTS RELATED TO OPERATION OF THE CENSUS UNIT	142
1.1 Personnel & General expenses	14
TOTAL	4,131

Source FAO Project document

Funding

4.45 In most countries, the government provides specific funding for the census from the national budget. The census is unlike many other activities of government that receive ongoing and relatively predictable allocations. The census budget is highly cyclical, with relatively low levels of spending through the preparatory and dissemination phases. There is a large peak during the enumeration and processing phases. Governments need to be aware well in advance of when the peak expenditure is likely to occur so that it can be planned.

4.46 The census must be designed in partnership with the interested government agencies so as to obtain their involvement in the census process. The possibility of sharing the census cost among National Statistics Office, Ministry of Agriculture, Ministry of Livestock (if separated from MoA), and other relevant national stakeholders should be further explored. In some countries, local governments also provide budget support for the census. These central and local government institutions could be supportive in providing logistics arrangements for the census, such as the use

³⁵ The budget does not include the cost for technical assistance

of existing infrastructure, transportation, communications facilities and the sharing of employees of other government agencies.

4.47 A high level committee which consists of the government agencies, the private sector and civil society, including non-governmental organizations, communities and donor community could be formed to advocate and discuss issues related to the cost and funding of the census (see also Chapter 3).

4.48 Many countries find it difficult to raise adequate funding to conduct the census in a timely manner. While ideally a government should bear the costs entirely, in some countries, the donor community becomes an important source of resources. Donors usually condition their contribution to concrete country commitment. In the case of external/donor funds, the required conditions should be established well in advance by discussion between the donor and the census agency. This will avoid delay in the release of such funds for census operations (see also paragraph 4.54).

4.49 When funds for census operations are provided by more than one source planned financial flows should be presented by source of funding, i.e. whether the expenditure comes from:

- ◆ the national budget specifically planned for census operations;
- ◆ other funds of the census agency(ies) (for example, a regular annual budget not specifically intended for census purposes);
- ◆ other government agencies;
- ◆ international donors, etc.

Monitoring and review of the work plan and the budget

4.50 Once funding is received, it is necessary to monitor expenditure against funding for the current and future years. It is recommended that, while budgets may be compiled on a yearly basis, they be monitored on a quarterly or even a monthly basis, with projections of the total expenditure for the current financial year. Each phase's performance should be monitored against budgeted funds. Regular reports should be produced for each phase, showing the annual budget, expenditure to date and estimates of expenditure for the rest of the current financial year and future years in the census cycle.

4.51 Therefore control measures and monitoring systems must be developed for cost effectiveness. Activities to be outsourced must be clearly defined and contracts for outsourcing well prepared with clear deliverables and timelines.

4.52 General review and coordination of changes in the plan are of great importance for large operations like a census. The census plan as executed will certainly change in a number of respects after the original calculations. Consequently, a perfect correspondence between the estimates and the final costs is not to be expected. Changes in the unit cost of major components of census costs should be monitored on a regular basis with either the census budget adjusted accordingly or the census plans modified. Throughout the period of census taking and compilation of census results, the budget will have to be re-examined and performance compared with plans.

4.53 Throughout the cycle of an agriculture census, changes are likely to be needed. Project objectives, priorities, availability of funds, questionnaire content, survey and processing methods and technologies are among the elements that may diverge from the original plan. To better manage the census operations, a continuous review of the progress of work should be provided to ensure that day-to-day operations are proceeding smoothly and as planned. Any over-expenditure must be detected early and checked promptly. This control is particularly important in relation to the

purchase of materials and supplies, printing of forms, field enumeration period, and processing of completed questionnaires.

4.54 Any delay occurring along any line of activity will have a chain reaction in the subsequent activity of the programme, affecting both work plan and budget. Ideally, the work plan should remain unchanged but whenever necessary changes are made in the plan and timetable, all key personnel should be informed. Changing the work plan must always result from an objective and rational analysis and be made by the census coordinator, not by pressure of unforeseen events.

4.55 In a large scale and complex project such as an agriculture census, where multiple and different partners, areas of service and stakeholders are involved in a series of interrelated activities, it is critical to have a well defined and structured approach to manage changes. If the resources allow, it could be a good practice to have a fully dedicated employee (trained in the discipline of project management) building, tracking and updating the plan, that produces regular progress reports to managers. Whenever it is possible, the census of agriculture should make use of known and common tools used in the organization. Hence, if control measures and monitoring systems are already in place in the organization, they should be used. Some countries use change management structure approach for identifying, evaluating, planning and integrating changes during the life cycle of a program, including a census. The example of Canada related to the Change Management process is presented in Box 4.1.

Box 4.1: Country example of Statistics Canada: Managing changes in a statistical program³⁶

At Statistics Canada, a formal Change Management process has been implemented for the Agriculture Statistics programs and for other Business Statistics Programs. One hundred or so programs are now subject to this formal procedure.

The process is coordinated by an independent **Change Management Unit**. Their role is to ensure that all change requests are properly documented in a corporate tool and to facilitate the right level of discussion and arbitration among all the relevant parties. All the change requests submitted are then formally reviewed by a **Change Management Committee**.

The Change Management Committee includes all involved stakeholders (representatives from the areas of service and subject-matter divisions). Their members:

- assess and evaluate the impact and risk, if any, of a change request on the various areas of service and subject matter divisions;
- quantify this impact in terms of effort, time, and resources;
- communicate the requested changes and their impact back to respective programs and divisions;
- provide an update of any changes from respective programs and divisions;
- authorize change requests and implement by consensus;
- provide recommendations to the project Steering Committee in absence of consensus.

For more information: [Link](#)

Preparation of expenditure control

4.56 The census office needs to implement transparent accounting procedures and financial management systems to ensure the efficient use of funds, in accordance with the national legislation

³⁶ Lee, Judy, Sandra Venturino (2016). *Integrated Business Statistics Program (IBSP) Change Management Overview*, Statistics Canada. Internal document.

and requirements of the funding agency. This would enable prompt release and control of allocations of census funds to the census office and from central office to the provincial and district offices. A clean outcome from a financial audit adds credibility to the census process so that the government and civil society are more likely to accept the final results.

4.57 A possible procedure would be for the central office to issue fund allotments for a census administrative area, such as a provincial office. The province would then sub-allot amounts to the different areas under its supervision (such as districts' offices) for their operational expenses, broken down as required, for instance into salaries and wages, travelling expenses, per diem, communication services, transportation services, other services, supplies and materials, rentals, equipment, etc.

4.58 In the meantime, the central office would keep an account of fund disbursements and reflect all types of expenditure incurred in a ledger account which would show on a current basis the amount spent for a project together with the unspent balance. The adoption of a coding system (if there are no specific requirements set up by financial instructions) whereby every type of expenditure would be identified with a code number would make computerization possible.

4.59 A prerequisite for establishing expenditure control is the availability of information on expenditure incurred and the corresponding output of work. It is therefore desirable to develop a system of progress reports at regular intervals, say once a quarter or month. Progress reports should be compatible with the form in which both the work plan and the budget have been prepared. It would also be desirable to include in the form information regarding the outputs expected to be achieved in the subsequent month/quarter and for the year as a whole. These data can then be matched with achievements of the relevant period.

Country examples-Links

Cambodia: Agricultural Census 2013: [Budget](#)

Republic of Moldova: General Agricultural Census 2011:

- [Work plan](#)
- [Aggregated budget](#)
- [Detailed budget](#)

Lao PDR: Agricultural Census 2011: Work plan and Budget

Nicaragua: Agricultural Census 2011: Work plan and Budget

Republic of Congo: Agricultural Census 2014/2015:

- Work plan
- Publicity plan
- Budget

Suggested reading:

1. UN, Principles and Recommendations for Population and Housing Censuses, rev 3: the 2020 Round, 2015
2. UN, Handbook on the Management of Population and Housing Censuses, rev.2
3. United Nations Statistical Commission and Economic Commission for Europe, Conference of European Statisticians, Costing Aspects of Population and Housing Censuses in Selected Countries in the UN/ECE Region, Statistical Standards and Studies, No. 46 (United Nations publication, Sales No. E.96.II.E.15).

CHAPTER 5 COMMUNICATION AND PUBLICITY STRATEGY

The main aim of census communication and publicity is to sensitize the public about the purpose of the census of agriculture and, ultimately, to ensure the cooperation of holders to provide complete and accurate data. This is an essential part of the census preparations and has to be planned timely taking into account local conditions. This section provides some suggestions on how develop and implement a cost-effective strategy for a communication program and publicity campaign well synchronized with census phases.

Importance of communication and publicity for the census

5.1 An effective communication programme, together with adequate publicity and information campaigns, play an essential role in ensuring the success of the census of agriculture. Public acceptance and cooperation is essential for the collection of truthful data. There are some census items, such as the size of the holding, extent of cultivation, livestock numbers, land tenure, etc., which may be sensitive. Holders may be reluctant to answer such questions or supply correct information unless they are aware that the information supplied by them will not be used for tax purposes or used against them in any way. The quality of the information will largely depend on the cooperation of the holders and their willingness to provide the requested information.

5.2 The general public, in turn, might have some concerns such as the benefits of a costly operation, privacy and confidentiality of information given, potential use of census information for non-statistical or other inappropriate purposes. The census publicity campaign should therefore be designed to sensitize the holders and the public in general about the purpose of the census as well as to inform them of the type of information to be collected and its use, primarily to achieve full cooperation of respondents. Another important purpose of census publicity is the promotion of census results at the time they become available (see also paragraph 4.4).

5.3 By increasing public understanding of the purposes of the agricultural census, response rates will be improved, which in turn will reduce the unit-cost per-respondent, and conditions will be in place for collecting quality data. A well-planned publicity campaign is therefore essential to create a favourable environment for the collection of census data.

5.4 One of the main functions of the Census Steering Committee is to prepare a coordinated communication programme and publicity campaign (see paragraph 3.2) in connection with the agricultural census with the aid of publicity experts. A special sub-committee might be set up to manage the census publicity campaign. The regional and local census committees would also normally be involved as agents for publicity in their respective areas. These committees are better positioned to make more efficient the publicity campaign for the census by taking into account the prevailing local social and economic context, the means of communication available, etc.

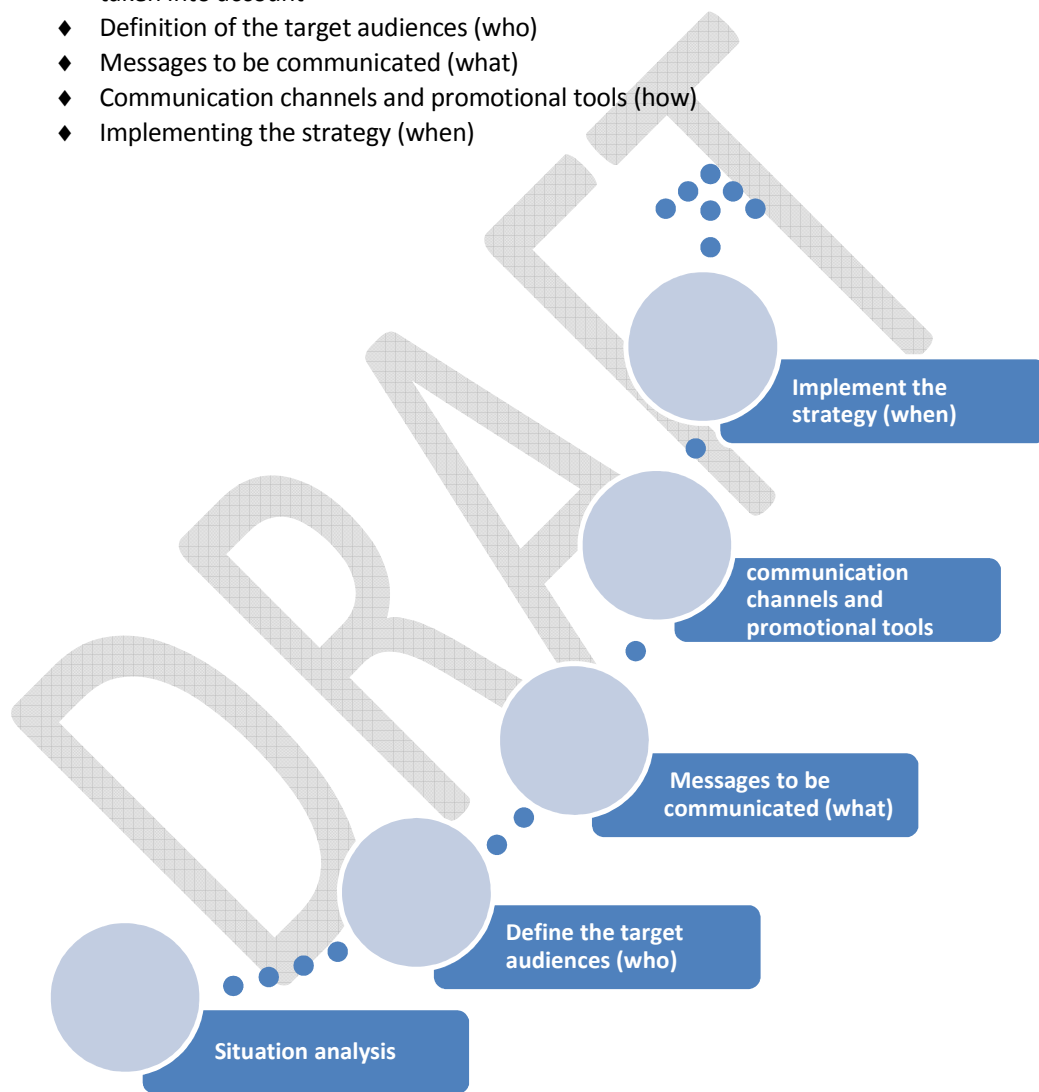
5.5 It is highly recommended that census agencies use professional communications specialists to plan and implement their publicity campaign. This also allows census management to concentrate on the technical aspects of preparing and conducting the census of agriculture. In the early stages of planning, key communications managers from within the census agency (where these exist) could be assigned to the census or external advisers appointed.

5.6 The main steps include developing a cost-effective communication and publicity strategy, implementing and monitoring the strategy and synchronising its timing and duration with relevant phases of the census depending on the census modality.

Developing and implementing a communication and publicity strategy

5.7 The first step for a communication program and publicity campaign is to develop a strategy. The strategy is concerned with deciding who are the target audiences, what are the key messages, how (the means of communication) and when (time of delivery). The following issues need to be addressed when preparing the strategy:

- ◆ A situation analysis that identifies any particular opportunities or issues that need to be taken into account
- ◆ Definition of the target audiences (who)
- ◆ Messages to be communicated (what)
- ◆ Communication channels and promotional tools (how)
- ◆ Implementing the strategy (when)



Situation analysis

5.8 A situational analysis includes a thorough examination of internal and external factors that may influence public support and cooperation of respondents when conducting the census of agriculture and is aimed at identifying the best solutions to implement a targeted and cost-efficient communication and publicity strategy. It provides a set of information and data against which the strategy will be designed. This analysis should be conducted applying qualitative and quantitative

methodologies, desk and literature review. The analysis covers public attitudes towards the agricultural sector, including the census of agriculture relationship between agricultural producers and the administration, the national communication environment and the most likely opportunities and difficulties to be encountered in communicating with holders and other audiences about the census.

5.9 Some of the key aspects that could be analysed include:

- ◆ The context (geographic, economic, political, administrative, demographic, social and cultural aspects)
- ◆ Features of communication for development, opportunities and constraints (including existing ICT infrastructures and potentialities, including Internet and mobile phone).
- ◆ Characteristics of the population. Socio-cultural (ethnic groups, literacy, languages) and gender specificities (status, roles, beliefs, attitudes), communication habits, including traditional and modern media (opportunities and constraints).
- ◆ Perception of the census and why some individuals or groups may not accept it.
- ◆ Institutions/entities and available resources in the communication sector: existing mass media (coverage, access, cost, programmes, efficiency); other media (group, traditional, new media); other channels, places, communication networks and languages. Opportunities and constraints.

Country examples: Republic of Congo (2013) and Cote d'Ivoire (2014) ([see links](#)).

Target audiences

5.10 The communication strategy of the agricultural census needs to be tailored to specific country conditions. The strategy is usually expected to reach three target groups more or less corresponding to the various census stakeholders, namely:

- ◆ **The first target group** consists of rural populations: women, men, heads of households, Agricultural holders.
- ◆ **The second target group** consists of intermediary actors. This group serves as interface between policy makers and the rural population which is to say between the first target group and the third target group. It has an influence on the rural environment and depending on country situation, includes: the civil society, decentralized services, journalists, development projects and programs, NGOs, village chiefs, groups of influential people (e.g. religious leaders, community leaders, teachers, and representatives of grower's organizations and farmers' associations).
- ◆ **The third target group** consists of the national government (in particular, the relevant ministries such as Ministry of Agriculture, Ministry of Livestock, Ministry of Fisheries, Ministry of Forest, Ministry Environment, Ministry of Economy, Finance and Planning) and development partners, particularly in developing countries.

5.11 The messages and communication means should be tailored to each target audience. The census of agriculture is a national activity that is completely dependent for its success upon the wholehearted cooperation and assistance of all the above audiences. Special attention should be given to targeting hard to-reach holders and ethnic rural communities in order to ensure consistent levels of response across the country.

Messages

5.12 Census agencies need to communicate a wide set of messages, including:

- ◆ make holders and other audiences aware of the census (and what it is) and its objectives;

- ◆ educate them about the benefits (to them and to the country) of the census;
- ◆ inform the holders that privacy and confidentiality will be protected;
- ◆ remind holders about their legal obligation and duty to take part in the census;
- ◆ explain to them what to do, when and enumeration modalities, including dates, duration, ways of data collection (personal interviews, self-interview, use of paper-based questionnaires or mobile devices, etc.), target population, number of visits, etc.;
- ◆ express thanks to the holders for taking part in the census;
- ◆ disseminate census results

5.13 A good balance should be kept between these different messages. For example, an over-emphasis on the obligatory nature of the census may reinforce any negative perception while obscuring its benefit. The message aim is to engage, educate, explain, and encourage and (if necessary) enforce participation (if required by law). Box 5.1 show the key messages of the US 2007 Census of Agriculture.

5.14 Publicity has to be directed at educating the holders, who are to supply the census information. They often have different levels of literacy, have their own prejudices and often do not perceive the objectives and relevance of the various inquiries. They may connect the purpose of an agricultural census, which is a comprehensive technical inquiry, with a possible increase of agricultural taxes, the compulsory procurement of agricultural produce and even changes in land tenure. To dispel these fears and to assure them that the inquiry is confidential and primarily for their own benefit is the purpose of the census publicity. Mindful of not creating unrealistic expectations, it should be explained in simple words how the agricultural census is an essential basis for formulation and implementation of various development programmes, such as irrigation projects, soil conservation, use of fertilizers, introduction of improved varieties of crops and animals, etc.

5.15 These programmes aim at increasing the production of their enterprises and thereby contribute to raising their standard of living. It should also be explained, in simple language, how inaccurate information supplied by them will adversely affect the planning of various programmes intended to improve their living conditions. In other words, it may be emphasized how accurate data help the holders and the government in planning the economic programmes for the holders' betterment, and how planning based on inaccurate data can harm them, as well as their country.

5.16 If the agricultural census involves a sample component (e.g. modules conducted on sample basis under the modular approach), this fact is likely to cause suspicion in the minds of both, the holders to be interviewed and those who will not be interviewed. To prevent unnecessary suspicion, holders must be explained in plain words why a holder will be selected for interview and not the neighbour.

5.17 The publicity campaign should also strive to inform key census data users about the availability of census data and its utility. This task must be coordinated with user consultations to be undertaken for the preparation of the census (see Chapters 6 and 14, respectively). The future availability and uses of census data must be included in the pre-enumeration campaign when public attention to the census is maximized. Influential people should be encouraged to provide examples of the ways in which their groups have used the results of previous censuses for the benefit of the community.

5.18 A good and common practice to communicate the message widely consists of developing a **logo** and **slogan** to be used in all types of media and promotional materials (e.g., booklets, posters, brochures, T-shirts, baseball hats and souvenirs). The purpose is to improve 'brand recognition' for the census from initial stages of the publicity campaign. The slogan and logo should be memorable and positively perceived. The aim should be to encourage the respondent to feel more reassured that the census is an inclusive and beneficial activity.

5.19 Examples of census slogans used by countries are shown below while some census logos are illustrated in Figure 5.1:

- ◆ USA 2012: There's strength in numbers
- ◆ El Salvador 2007-2008: The agricultural sector also counts
- ◆ France 2010: For a complete vision of agriculture today, each one of you counts
- ◆ Botswana 2015: Make a difference to the future of agriculture in Botswana
- ◆ Uruguay 2011: We count on our people

Figure 5.1. Examples of census logos used by countries



2011 Census of Agriculture, Costa Rica



2012 Census of Agriculture, The Philippines

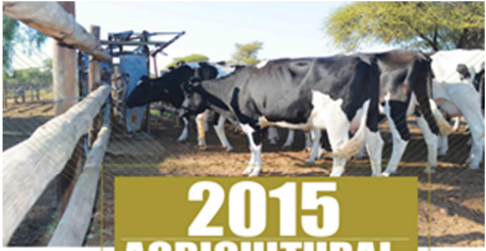
2010 Census of Agriculture, France



2015 Census of Agriculture, Botswana



2010 Census of Agriculture, Ireland



2015 AGRICULTURAL CENSUS

Make a difference to the future of
Agriculture in Botswana

January 2015 - September 2015
Data Collection from Traditional holdings

September 2015 - December 2015
Data Collection from Commercial holdings



Participate with the rest of Botswana's Traditional and Commercial Holders.
Allow Statistics Botswana to collect information from you.

DRAFT

Box 5.1. US 2007 Census of Agriculture Key Messages



What is the Census of Agriculture?

The Census of Agriculture is a complete count, taken every five years, of America's farms and ranches and the people who operate them.

It is the most complete agricultural data resource available, providing the only source of uniform, comprehensive information for every county in the nation.

The census provides information on land use and ownership, operator characteristics, production practices, income and expenditures, and many other important topics.

The 2007 Census of Agriculture is your voice, your future, your responsibility.

Agriculture's Voice

By participating in the 2007 Census, producers can help show the nation the value and importance of U.S. agriculture.

This is an opportunity for every producer to show how agriculture contributes to America by providing food, fuel and fiber.

Each producer has the power to influence key decisions that will shape the direction of American agriculture for years to come, including:

- | | |
|------------------|---|
| Farm services | Production practices and new technologies |
| Policy decisions | Transportation and marketing locations |

The Future

By responding to the Census, every producer can have a positive impact on the future of their own operation and their entire community.

The Census provides valuable information used for:

- | | |
|--------------------------|---|
| University research | Extension Outreach and Education |
| Community planning | Availability of operational loans and other funding |
| Farm succession planning | Location and staffing of USDA service centers |
| Store/company locations | Federal budget support for agriculture |

Everyone's Responsibility

Everyone's response to the Census makes a difference!

To assure we are providing the best tools and reports, we need accurate information from *all* farmers and ranchers – no matter how large or small their operations are.

This information is used to make a positive difference in local communities.

Additionally, responses are required *and* protected by law.

What to Do?

- Producers should look for the Census form in their mailboxes in early January.
- Forms must be mailed back or completed online by February 4, 2008.
- Visit www.agcensus.usda.gov for more information.

What to Expect?

By participating in the 2007 Census of Agriculture, producers can expect in return:

- Summary reports in both print and electronic formats once Census data is compiled.
- Information that's a valuable planning tool for their communities and their individual operations.
- Complete confidentiality of individual responses.
- An agricultural voice!

Communication channels and promotional tools

5.20 The communication strategy concerns all the actors or audiences in the agricultural census. To reach out to them, several channels (e.g. media) and communication tools can be used. The types of

publicity media and promotional tools used will largely depend on availability and on a country's socio-economic structure. The extent of media and promotional tools use will vary according to the conditions in a country and the resources available. The communication approaches adapted to target audiences include:

1) *Promotional tools*

- ◆ Meetings with the highest national and regional authorities.
- ◆ Design and distribution of promotional tools:
 - Promotional materials (flyers, brochures, information notes for policy makers, etc.).
 - Cinema films, videos and slides exhibited in mobile vans in rural areas.

2) *Mass communication (radio, television and press)*

- ◆ Use of state and rural radio and television stations, and popular programmes on agriculture.
- ◆ Design and dissemination of press products (commercials, reports, documentaries, press releases, press kits, etc.).
- ◆ Production of promotional materials (wall posters, banners, caps, T-shirts, brochures, notebooks, booklets, pamphlets, calendars, USB sticks, stickers, souvenirs, comic books, etc.).
- ◆ New media (social networks such as Facebook, Twitter, YouTube, Instagram, blogs, etc.).
- ◆ Text messages and voice broadcasts (voice messages) on mobile phones (in collaboration with Telecom companies).
- ◆ Organizing a press lunch in order to provide an opportunity for journalists to be better informed on the various census operations.
- ◆ Purchase spaces in the most read newspapers
- ◆ Census stands in the national exhibitions and agricultural fairs.

3) *Social mobilization*

- ◆ Rural community service announcements, agricultural extension agents, school teachers and Sunday mass services spreading the word.
- ◆ Educative dramas and plays broadcasted in the main national languages;
- ◆ Use of town criers to make public announcements on the census in rural areas (particularly in Africa).

4) *Institutional communication*

- ◆ Setting up an Internet website on the agricultural census office (with Frequent Asked Questions FAQ to be updated continuously).
- ◆ Dissemination of a short newsletter with regular updates.
- ◆ Call center (telephone inquiry service to address any specific questions on the census).

5) *Interpersonal communication*

This method involves direct contact and networking with relevant audiences of the target groups and collection of feedback. Meetings can be organized and regular contacts held with the second target group. This helps spread the message about the importance and utility of the census within their organizations and possibly through their networks of contacts.

Implementing the strategy

5.21 The implementation of a communication and publicity strategy for the census of agriculture should consider and be adapted to the national context (e.g. geographic, economic, political, administrative and technological), characteristics of the population (demographic, social and cultural) and the communication opportunities and constraints. The message and use of communication means (including mass media, promotional tools and activities) should be attuned according to the target audiences.

5.22 The implementation of the strategy should seek to make the census an event of national importance and public interest. The implementation involves a series of actions which could include the following:

- ◆ Organizing successive media events to launch the census campaign, complemented by the issuance of press releases and background material for use by the media. Other events could be organized regularly to inform the audiences about the progress of census activities and preliminary results.
- ◆ Building awareness through effective media advertising and active media program of information dissemination in the major national languages.
- ◆ Influencing key public members to support the census publicly (the President, Minister of Agriculture, politicians, leaders, personalities and representatives of respected institutions).
- ◆ Building support through third-party endorsements such as grower associations, farmer cooperatives and influential NGOs.
- ◆ Being proactive in public debates about the agricultural census and associated issues.
- ◆ Organizing data users meetings (to request feedback and obtain buy-in on questionnaire content).
- ◆ Training census staff to act as media spokespersons or to answer enquiries
- ◆ Developing lists of expected questions and standard model answers on key issues
- ◆ Monitoring the public debate and media coverage.
- ◆ Developing specific campaigns for each target audience
- ◆ Recruiting census enumerators through advertising
- ◆ Village meetings and community service announcements.
- ◆ Educating and informing religious leaders, community leaders, village headmen, elders and other persons of influence.
- ◆ Distributing posters and pamphlets with the census logo and slogan for placement by regional supervisors in suitable locations in rural areas.
- ◆ Broadcasting short and catchy songs with census message lyrics in different languages thorough radio and television.
- ◆ Organising contests with the agricultural census theme (such as drawing competitions for children in Russia, Moldova, etc.) for selecting the census logo and raising public awareness about the census.
- ◆ Lectures in rural schools (children can pass the message on to their parents)

Boxes 5.2 and 5.3 show publicity strategies implemented by two countries.

Box 5.2. Publicity strategy from the 2013 Census of Agriculture in Cambodia

Prior to the Census a Publicity Committee consisting of senior level representatives from different ministries and national institutions of Cambodia was formed. Before fieldwork began a thorough advocacy plan was launched to gain the support and cooperation of all households and non-households engaged in agricultural activities in the country.

- Village leaders were enlisted to provide information locally to the areas of enumeration using local channels of communication.
- An awareness campaign was undertaken in the mass media, including broadcasts on television and radio.
- Printed banners, posters and stickers on bags in addition to printed T-shirts and caps were used during the census and surveys.
- Leaflets and pamphlets were also prepared with explanations to such questions as: What is the Census of Agriculture in Cambodia (CAC)? What agency is responsible for the conduct of CAC? How essential is the CAC 2013?

Source: Advocacy Plan, Census of Agriculture in Cambodia report 2013

Box 5.3. Publicity strategies from the 2011 Census of Agriculture in Canada

For the 2011 Agriculture Census in Canada a Census Communications Team was formed with the main goal of providing communications support for the collection and the dissemination phases of the 2011 Census of Agriculture. Additionally, the responsibility of the Census Communications Team was to provide pro-active creative and cost effective communications programs, while maintaining a positive, non-partisan, corporate image of Statistics Canada.

- Electronic text messages were used to target difficult-to-enumerate groups and to inform respondents of the need to complete the questionnaire accurately and to return their questionnaires quickly among other reasons.
- Media: Editorial boards with newspapers and news magazines were used to promote the census.
- Emails and letters: were also sent from the census manager or the regional director requesting support for the 2011 Census. In addition, those who were hard to reach in other ways also got communication via the means of letters and emails.
- Paid advertising: Out-of-home advertising was placed in public locations such as bus shelters, on the outside of buses, subways, and billboards at the start of the drop-off/mail-out stage.
- Radio: radio ads were also used to build awareness on the census. Advertisements were translated into several languages for ethnic print and broadcast media. During the enumeration period, the message focused on calling the Census Help Line so that Statistics Canada staff could help respondents to fill-in their questionnaires over the phone.
- After Census Day, the messaging changed to a clear reminder that there was still time for people to send in a census form.
- Website: this was the primary response option and in turn it was used to promote the census, to provide information and instructions on completing the questionnaires.
- Posters: promotional materials for the 2011 Census were available free of charge and these played an essential part of the communications concept.

Source: Overview of the Census, Chapter 3. Canada 2011.

5.23 The implementation of communication and publicity actions illustrated above need to be adapted by countries taking into consideration their own particular circumstances. The implementation of such actions should be carefully timed and monitored as discussed below.

Timing and duration of the communication program and publicity campaign

5.24 The publicity for the agricultural census should start slowly and reach a climax at the time of the census enumeration. The census enumeration may take few weeks if the census modality, for instance, is a one-off operation such as the classical approach, or spans over several months or years and involves one or more visits to the holders such as in the modular and integrated census/survey modalities. Therefore, the intensity of the publicity and nature of the messages should be tailored to the census modality and duration of the field work.

5.25 Some of the early publicity can take the form of news items, contributions to the regular agricultural radio, TV programmes, etc. This publicity can explain the general aims and purposes of the census and cover the broader issues. The pre-test and pilot censuses can also be useful components of the publicity campaign. The procedure for conducting the census and details of the information being collected should be explained near the beginning of the actual census. The primary contacts in a census operation are the holders; they have to be convinced of the importance of their answers to the census. Any campaign considerably in advance of the actual interview will have limited influence on the holders' understanding of the questions and the importance of correct answers.

5.26 Once the holders are convinced of the usefulness of the census, they are usually interested in the final results. It is desirable to keep them informed about the findings of the census undertaking. The holders may not remember having participated in an enumeration which possibly took place some time ago. Then the publicity campaign should be reactivated and oriented towards the presentation of national census results. This should be done through the radio, television, newspaper media and web streaming when the final results of the census are released for general use (see Dissemination Plan in Chapter 23).

5.27 Implementation of the publicity program is best undertaken by experts in the field of public relations, advertising and sociology. Such expertise is frequently not found within the census office itself, and it may therefore be appropriate to outsource some or all of this work.

5.28 It is desirable that planning for the general publicity campaign should start at the outset of census preparations. Plans for the campaign should be closely coordinated with those for the pilot census. The campaign can use the pilot census to study the impact of alternative publicity materials and methods. If the mapping or listing operations require extensive fieldwork and contact with the holders, the publicity campaign should take this factor into account and prepare the field staff accordingly.

Monitoring

5.29 The implementation of a communication programme and publicity campaign requires early and continuing monitoring about the reactions to the census plans and attitudes of holders, key persons and main stakeholders.

5.30 The census agency should monitor holders' opinion and the mass media to assess the effectiveness of publicity campaigns. Performance indicators can help to measure the effectiveness of the communication programme through metrics such as the number of hits, number of views, media

impressions, numbers of tweets and re-tweets, etc. Holders' opinion could be monitored through surveys to evaluate their attitude to the census. Monitoring of mass media involves an analysis of mass-media publications concerning the issues of the census and their audiences. The feedback from the monitoring allows fine-tuning the implementation of the communication program. It also enables detection and prevention of possible negative comments and wrong perceptions on, and attitudes to

Box 4. Monitoring of the communication and publicity strategy for the 2011 Census of Agriculture in Moldova

the census as well as the preparation of adequate responses.

Budget

5.31 The costs associated with the preparation and implementation of a communication program and publicity campaign for the census of agriculture are usually underestimated in the planning phase. It is therefore important that sufficient resources are allocated in the census budget to ensure a quality outcome.

5.32 A cost-efficient communication and publicity strategy should be based on a detailed evaluation of the factors that may affect the achievement of the objectives, seize the opportunities available and deal adequately with the constraints. Many communication strategies can be implemented on a limited budget. For example, the use of government-operated mass media with national and rural coverage (which usually do not imply additional costs for the census agency) should be emphasized. Commercial stakeholders that make use of census data may offer their communication channels to publicize the census. Low-cost communication strategies, utilizing new media platforms, can have a high impact even when resources may be limited for a publicity campaign. In countries where information technology is fairly developed, internet, social networks and other low-cost communications strategies can also help to cope with limited resources for a publicity campaign.

5.33 Other creative ideas when working with a limited communication and publicity budget include:

- ◆ Mobile communications companies can send free texts reminding subscribers of the census date and the importance of the census
- ◆ Religious leaders can spread the census message during services leading to the census date
- ◆ Utility companies can print a reminder of the census date on utility bills

Box 5. Budget of the communication and publicity strategy from the 2014/2015 Census of Agriculture in the Republic of Congo

5.34 Investment in good communication have a real impact on the quality of data from the census of agriculture.

Suggested reading

UN (2016). Handbook on the Management of Population and Housing Censuses, Revision 2

CHAPTER 6 TABULATION PLAN

The tabulation plan outlines the presentation of information obtained from the agricultural census for the data users. It is needed at an earlier stage of census preparation for defining census' content and developing the questionnaire, as well as for planning and organizing the data processing and tabulation of census results. It should describe in detail the structure of the presentation of the summarized data, with an indication of the priorities, so that data processing staff can plan their work, and users can plan further analysis of the agricultural sector data.

The tabulation plan should be based on extensive discussions with data users, and should include all required cross-tabulations. In particular, the tabulation plan should indicate proposed tabulations by administrative units and agro-ecological zones, taking into account the features of the census modality and limitations in producing tables for small areas when conducting a sample enumeration.

Introduction

6.1 The primary form of presentation for statistical data is the statistical table. The tabulation plan for an agricultural census is the set of prototypes of statistical tables (dummy tables) prepared to present the main census results³⁷ and must respond to the needs of data users. The present section deals with the preparation and presentation of the tabulation plan.

6.2 The importance of a tabulation plan can be viewed from a number of perspectives. As indicated in Vol.1, the existence of a tabulation plan is paramount for developing the census questionnaire and to ensure that all relevant census information is included. It is important that data for all census items are tabulated; otherwise, the user will question why the data were collected. The development of the tabulation plan will indicate if data to be collected will yield useable tabulations. However, the tabulation plan will not only point out what census information is missing, but also reveal what is superfluous.

6.3 Therefore, the definition of census tables should start at the early stage of census planning, in consultation with users, when census contents and census methodology are discussed among the main stakeholders. The tabulation plan would be reviewed during the actual preparation of census questionnaires and also would be revised/adjusted when processing census information.

6.4 In addition, the tabulation plan may have direct implications for the census design. For example, data requirements for lower administrative levels will affect decisions taken in choosing between complete or sample enumeration, or in deciding the size of the sample in sample enumeration censuses.

6.5 The tabulation plan is needed as well for planning and organizing the data processing. The kind, size and number of tabulations required may influence selection of software and, at times, even the hardware requirements. However, such decisions have to be made months or sometimes years before the actual work is done.

6.6 The preparation of the tabulation plan is an iterative process: census questionnaire and also census methodology are conditioned by the data to be tabulated and, on the other hand, tables depend upon census questions and also census methodology. For example, if sample enumeration is

³⁷ These are mainly the priority and standard tables responding to the needs of the majority of users. Customized tabulations, in addition to the tabulation plan may be produced on demand using census databases (see also paragraph 6.12)

used (as in the case of the modular approach or the integrated census/survey modality), tabulation for small areas or for rare items will not be possible because of large sampling errors or lack of appropriate information.

6.7 A number of other census activities may benefit from knowing the tabulation plan, such as planning the tabulation of preliminary census results, computer validation and editing of data, planning the publication programme, etc. In some countries, data processing may be decentralized with provincial offices responsible for data processing and providing the required tables at the provincial level, and preparing any other tabulations required by local authorities and other users.

6.8 After the items to be tabulated have been determined and corresponding questions have been included in the questionnaire, the manner of arrangement and presentation of these data into tables for analysis and publication can be decided. One should bear in mind that the table format should be meaningful, significant, and user-friendly. The tabulation plan needs also to take into consideration the requirements of insuring the consistency and comparability with other national statistics, as well as international comparability of key census tables based on the use of tabulation classes recommended by FAO and standard units of measurement. The manner of arrangement and presentation of census results into tables for analysis and publication is often subject to corporate guidelines and existing platforms used at the statistical agencies. Harmonizing the presentation of data among the various programs helps the integration and comparability of multiple datasets and limits the IT development work, existing programs being re-used.

6.9 One important point when preparing the tabulation plan and during the revision of final tables is preservation of confidentiality of census data. If data are classified too finely in cross-tabulations, table cells may be based on only one or two observations and reporting holdings could be identified breaching confidentiality. This is crucial when presenting web-based data because if appropriate precautions are not taken, users could have access to individual information breaking confidentiality rules.

6.10 The present section deals with the different stages of preparation of the tabulation plan, the main elements to be taken into account when preparing the tables in the framework of different census modalities, the particularities of cross-tabulation with community level data. Finally, relevant country examples are presented.

Main steps in the development of a tabulation plan

6.11 The development of the tabulation plan (with prototypes of tables) is an iterative and dynamic process and is organized in several phases:

- ◆ Development of the preliminary tabulation plan based on results of user consultation, with ongoing revisions applied as further consultation takes place. This, in turn, include the following steps:
 - Evaluation of user's requirements;
 - Designing the first set of tables at the stage of defining the content of the census and designing the census questionnaires, in consultation with main users; a good starting point for the development of a tabulation plan would be the use of a similar plan from the previous census of agriculture, taking into account the planned changes in the census content and the lessons learnt;
 - Designing a comprehensive tabulation plan for planning and organizing data processing and its review by data processing staff to verify whether the desired tables can be programmed; In this respect it is important the tabulation plan to be accompanied with all the necessary information for the development of

data processing/tabulation applications (e.g. calculation formulas for each cell of a table);

- ◆ Coding and production of prototype tables using test data (pilot census data). This will also serve as a test for the production and output systems.
- ◆ Finalizing tabulation content. It is important to set a definite deadline for this and to adhere firmly to this date.

At the later stage, for the production of tabulated data products, when census data will be processed, the prototype tables prepared during planning stage will be populated with census results. At this stage, usually further adjustments to the tabulation plan might be needed, as well as additional, customized tabulations (where appropriate) will be produced.

Figure 6.1 Developing a tabulation plan: main steps



6.12 In respect of the time of production and release of tables with the census results, the tabulation plan will consist of:

- ◆ Priority tables which contain the information of high priority and which should be released as early as possible. These tables may be preliminary results from manual tabulations prepared by field supervisors, based on totals for the most important characteristics at the end of field enumeration. These tables can also be a subset of the census data; either a representative sample, or a geographic subset. These tables generally are provisional and are replaced at the later stage, with the similar tables based on final census results (see also Chapter 23).
- ◆ Standard tables with final results, which are designed to be most useful to a large spectrum of data users and enable international comparisons. To assist in the creation of an appropriate group of these tables, a checklist of main classification variables and commonly used cross-tabulations is shown later in this chapter.
- ◆ An additive subset of tables, which incorporate country needs and priorities, as well as the production of statistics in line with international standards and FAO recommendations (which have not been inserted in standard tables) can also be processed. These tables may either be planned from the beginning or may be added at a later time. During development of the processing for all tables, an agricultural census database should be designed and used. Additional customized tabulations can then be produced upon request using this database.

6.13 When preparing the tabulation plan the following should be kept in mind:

- ◆ The number of priority tables should be restricted in order to make them quickly available to permit rapid dissemination. These tables may include key data collected with limited cross-tabulations or possibly in different volumes so that the more important data are available very early.
- ◆ Further analysis should be facilitated by:

- providing additional cross-tabulations;
- making available facilities for the production of special tables requested by users. In this respect, it can be said that with new developments in ICT, it has become more and more useful and practical to generate tailor-made tables online;
- making available safe access to microdata, ensuring data anonymization and statistical disclosure control (for details see Chapter 23).

Evaluation of user's requirements and user consultations

6.14 Ensuring that user needs are carefully considered is an essential element of census planning. The purpose of the consultation process is to satisfy user requests to the extent possible. Such consultations, carried out through census advisory and other groups and committees, roundtables, workshops, etc. is an efficient, transparent means of determining the users' demand for census outputs, including tabulations.

6.15 Communications between producers and users of statistics should, therefore, be established early in the preparatory stages of the questionnaire. The agricultural census office should observe and take note of the type and frequency of requests received from various users and catalogue the demand and identify data which may not be available from other sources.

6.16 In Chapter 4, the importance of consultations with users at the beginning of census planning (including in the users-producers workshops) has been especially highlighted. Meetings of main stakeholders with census staff should be organized to discuss main objectives, approaches, characteristics, scope, content and other aspect of the census. In a typical users-producers workshop many different demands are provided to include particular questions in the census questionnaire. A good practice is to ask the attendants to propose dummy tables (or, at least the characteristics to be cross-tabulated) that are expected to be derived from such questions. It is a way to ensure that the questions are relevant and that all the collected data will be tabulated.

6.17 When possible, a formal consultation/outreach plan could be developed to have on-going and periodic consultations with the key users of agricultural statistics as opposed to a large round of consultations every 10 years. This would also be beneficial for the survey program on the production of agricultural statistics, as key requirements and data gaps would be identified and addressed on an on-going basis based on the latest socio-economic context and the statistics provided by regular surveys and administrative registers.

6.18 The preliminary tabulation plan along with the first draft of the census questionnaire should be presented to main users of census information to receive their feedback and new inputs.

6.19 The importance of forming a group of experts drawn from user organizations for formulating the questionnaire is discussed in Chapter 14 below. This group should involve professionals who know the issues related to agricultural economic development and who can identify corresponding data needs. The group may assess past census tabulations and select those to be retained. New data needs should also be presented and discussed. Tabulation plans of neighbouring countries may also be useful. The work on tabulation plan should be synchronized with the design of the questionnaire to ensure that items needed in the tabulation will be collected and recorded on the questionnaire.

6.20 The main point to retain is that each data collected and recorded in the census questionnaire is tabulated and only data to be tabulated are included in the census questionnaire.

Importance of international comparability

6.21 International comparison of national census data is one of the important criteria of statistical quality and is based on the use by countries of standard concepts, definitions, methodologies and classifications. To enable access to internationally comparable census data, countries need to take into consideration that international comparisons require standard tables for all countries. Important in this respect is the use of FAO recommendations and international standards for tabulation classes. In this sense it is important that countries adhere to classifications recommended in Vol. 1, Chapter 10 and if countries wish to use different class groupings in their standard reports, they should also report the results according to the guidelines given there for international comparison purposes.

6.22 In order to preserve international comparisons, use of standard units of measurement is also very important. For example if a country uses local area units which are different from hectares in its tables, area should be converted to hectares to maintain international comparisons.

Presentation of the tabulation plan

6.23 The first consideration about a tabulation plan relates to which characteristics will be used to classify the data. Those characteristics are the “classification variables” (See Vol. 1, paragraph 10.5). For example, if the tabulation plan establishes that data about area irrigated will be presented for holders of different ages, “age of holder” is a classification variable. Most censuses contain some *main classification variables* that are used in many tables (see paragraph 6.36 below).

6.24 The second consideration refers to “**tabulation classes**”. When preparing the tabulation plan a decision need to be made about the classes that comprise the classification variables. Should “age of holder” be presented as: “under 25 years old”; “25 up to 34 years old”, etc. or instead as: “under 20 years old”; “20 up to 30 years old”, etc. Often, there are international standards and countries should adhere to those wherever possible to allow comparisons between countries. Attention should also be given to consistency between statistical collections in the country. Recommended tabulation classes for use in the agricultural census tabulation plan are presented in Vol. 1 (see Table 1, paragraph 10.7).

6.25 Finally, the type of data a table should contain are called “**summarized measures**”. Typical summarized measures are: totals (for example “total number of holdings” or “number of holdings with livestock”); averages (e.g. “average agricultural area per holding” or “average area irrigated per holdings with irrigation”); percentages (for example “percentage of holdings using chemical fertilizers”).

6.26 When possible, classification variables, tabulation classes and the summarized measures in the tables with census results should be harmonized with the agriculture statistics and other statistics programs. This would enable the comparability, coherence, integration and analysis of the census data with other official statistics.

6.27 Each table should contain enough metadata, such as a descriptive title³⁸ and indication of source. A reference to **titles of tables** in the tabulation plan deserves a comment. The title of a table is very important to inform the user about the content of the table, the classification variables used and the summarized measures employed. It should begin with Table Number, followed by the type of information tabulated, first classification variable (usually in rows), second classification variable (usually in columns) and (in brackets) the measure used (if a single unit of measurement is used in the table, otherwise, the units will be indicated in the column headers or row stubs, as appropriate). Explanation notes, at the bottom of the table, may provide any additional information needed to understand and use the data correctly (e.g. specific coverage of the table). For example a typical title could be: “Table 7: Total area of agricultural holdings by legal status of holder and by main purpose of production of the holding (in hectares)”. Such a table would content in each cell (i,j) the total hectares of holdings under the legal status *i* (for instance: “civil person”) and the main purpose of production *j* (for example: “mainly for home consumption”).

6.28 The tabulation plan should be divided into groups of tables (e.g. chapters, sections) according to their scope, coverage and topics.

Scope

6.29 When an agricultural census is combined into a single enumeration system with other censuses such as census of aquaculture (in the case of a census of agriculture and aquaculture) the tables referred to the overall joint census exercise and those related to the agricultural and other (e.g. aquaculture) holdings should be clearly distinguished and specified.

Coverage

6.30 The groupings of tables will largely depend on the census modality, especially if the census is conducted in one-off operation (in a classical census) or in several phases, such as in the modular census or an integrated census/survey modality.

6.31 When a single questionnaire is used (in a classical census), all census data will be available for all holdings covered by the census. Therefore, the data for all items included in the census questionnaire will refer to the same coverage. However, different questionnaires with different coverage may be used in the classical census, e.g. under a short-long questionnaire concept or using specific census questionnaires for different target populations. In this case, in addition to common tables for all holdings, specific tables should be designed for holdings covered by more detailed questionnaires (e.g. holdings from the non-household sector, holdings above an established threshold or belonging to a particular segment of the population).

6.32 When the modular approach or the integrated census/survey modality is used, the groupings of tables would refer to different modules and questionnaires (especially when these are conducted in different phases and refer to different reference periods).

6.33 In addition to the tables with overall national coverage, data could be presented at the subnational level – by administrative units (e.g. provinces, districts) or agro-ecological zones too, as allowed by census design and census questionnaire (see paragraph above and paragraph 14.50 in Chapter 14).

6.34 In the tabulation plan for a wider agricultural census (see Vol.1, paragraphs 5.46-5.50), the tables for three types of statistical units would be specified: (i) agricultural holdings in the household sector; (ii) agricultural holdings in the non-household sector; and (iii) non-agricultural production households.

³⁸ The table title should give a clear and accurate description of the data. It should answer the three questions “what”, “where” and “when”. Be short and concise, and avoid using verbs.

http://www.unecp.org/fileadmin/DAM/stats/documents/writing/MDM_Part2_English.pdf, p.12

6.35 Community-level data may be used to complement the data collected at the holding level, especially regarding the area of agricultural land³⁹ not operated by a holding and this should be reflected in the tabulation (in the explanatory notes of the tables or in the relevant section).

Topics

6.36 Examples of the groupings of tables by topics in the tabulation plan are the census themes presented in Vol.1 (general characteristics of the holdings, land, irrigation, crops, livestock, etc.)

6.37 In the tabulation plan it should be taken into account that when producing a series of tables for a publication or a website, the same layout should be used in all tables. Consideration should be given as to how much information needs to be provided in table titles (what is obvious and what is not), in the explanatory notes and be consistent in the use of abbreviations.⁴⁰ A practical consideration when presenting census results is for two pages tables to be in odd and even pages to have a good layout.

6.38 The current census Programme defines nine main classification variables recommended for tabulations of essential items when census reports are produced (see Vol. 1, paragraph 10.11):

- ◆ *Administrative unit or agro-ecological zone (from item 0101)*
- ◆ *Legal status of agricultural holder (type of holder) (item 0103)*
- ◆ *Total area of holding (item 0201)*
- ◆ *Area of agricultural land (from item 0202)*
- ◆ *Number of livestock (for a particular livestock type) (items 0502a–0502f)*
- ◆ *Main purpose of production of the holding (item 0107)*
- ◆ *Household size by sex and age group (item 0801)*
- ◆ *Sex of agricultural holder (item 0104)*
- ◆ *Age of agricultural holder (item 0105).*

The specification and use of the classification variables are discussed in Vol.1., paragraphs 10.11 – 10.20.

6.39 Census tabulated data will commonly be produced to correspond to administrative units, such as provinces, districts, villages. The tabulations could also include agro-ecological zones and/or statistical areas, such as enumeration areas. However, there are limitations in the presentation of geographic data due to the census data collection methodology (see paragraph 6.57 below).

6.40 Tabulation of essential items according to the nine main classification variables and using the tabulation classes recommended by the WCA 2020 constitute the main census tables. Additional tables will be added by countries according to their own needs.

6.41 Community-level data in an agricultural census can be tabulated in two ways: first, to summarize the characteristics of communities; and second, to use as classification variables for tabulations of census holding-level data. For the latter purpose it is important to be able to link each holding with its community.

6.42 The latter case is feasible when a community survey is taken along with the agricultural census, community-level data being used as classification variables for tabulations against some of

³⁹ For example, land in holdings may not represent the total amount of land used for agricultural purposes because of the existence of agricultural land not belonging directly to any agricultural holding – such as common agricultural land used for grazing (communal grazing land). This is important especially for pastoral areas, where considerable expanses of land may fall under community control. Thus, complementing holding-level land use data with community-level land use data will provide a complete picture of land used for agricultural purposes at the national and subnational levels (Vol.1, paragraph 9.6).

⁴⁰ http://www.unece.org/fileadmin/DAM/stats/documents/writing/MDM_Part2_English.pdf, p.14

the essential items such as number and area of holdings. The selection of community-level classification variables for the tabulation of holding-level data will depend on the content of the community survey. However, the following community-level classification variables are suggested:

- ◆ *Access to urban centre*
- ◆ *Risks of natural disasters*
- ◆ *Economic status*
- ◆ *Occurrence of seasonal food shortages*
- ◆ *Presence of a periodic or permanent agricultural produce market*
- ◆ *Access to veterinary services*
- ◆ *Access to farm input trading centre*
- ◆ *Access to credit institutions*
- ◆ *Access to farmers' association*
- ◆ *Presence of specific development projects.*

The specification and use of the classification variables are discussed in Vol. 1, paragraph 10.32.

6.43 When aquaculture data are collected in the agriculture census or in a joint aquaculture and agriculture census, each item related to aquaculture should first be tabulated by administrative unit or agro-ecological zone. A number of cross-tabulations for aquaculture can be considered, both within the aquaculture items themselves and with the agricultural holding items. Seven main classification variables are recommended in Vol.1 (see paragraph 10.34) for tabulations on aquaculture. These are made up of six items used for agricultural census tabulations and one item specific to aquaculture ("area of aquaculture"). Countries should determine their priority set of cross-tabulations dependent on the availability of aquaculture items to be provided by census data collection and users' needs.

Cross-tabulations

6.44 Tabular presentation may vary from country to country. One of the objectives of an agricultural census is to describe the structure of the agricultural sector. Cross-tabulations of different holding characteristics by main classification variables can show the influence of various factors on agricultural production. However, it is a common practice to first determine the items or characteristics to be classified and the tabulation classes to be used and then decide on the various levels of classifications. This work is done with the systems analyst who will implement these requirements.

6.45 Basically any table in the tabulation plan is cross-tabulated. There are basic cross-tabulations presenting different types of summarized measures (see paragraph 6.24). Often, more complex cross-tabulations are prepared, showing census data classified by two different items simultaneously, like two-way tables showing the characteristic classified by two classification variables. An example of a cross-tabulation is a table showing the number of holdings classified by area size classes against age classes of the holders). There are also more complex cross-tabulations like three-way tables. Careful planning at an early stage is needed to determine which data will be shown at which levels of administrative units. This plan can be shown as a part of the table of basic cross-tabulations.

6.46 There are a very large number of possible two way cross-tabulations and an even larger number of three-way tabulations, such as number of holdings classified by age of holder, area of holding and region. For the main census report, two-way tables should only be considered in very special cases and three-way tables should be avoided. Complex cross-tabulations are particularly useful for in-depth studies and here the analysts should have access to the on-line database so that they can tailor and generate their own specific set of tables.

6.47 The most common cross-tabulations for the essential items are summarized in Table 2 of Chapter 10, Vol. 1. When preparing the tabulation plan it is important to perform a “check” list in order to verify that all pertinent cross-tabulations have been included.

6.48 One main classification variable presented during census tabulation is total area of holding. Tabulations using this classification would show distribution of land resources and other characteristics of the holding by size, useful as a basis for government policies on agricultural land and land reform programmes. The size classification which has been used in reporting past censuses should be retained for continuity and comparability, but adhering to the tabulation classes recommended by FAO (see Table 1, Vol. 1). Furthermore, attention is increasingly being drawn towards operators of small holdings and toward holdings where the holder is female, with a number of studies and projects aimed at providing assistance.

6.49 Total area of holding, as it relates to production or rate of productivity, has limitations because total area of holding may include those areas not used for agricultural production. Another main classification of holdings is by area of agricultural land. This classification has a direct advantage over that based on total area of land as it is more directly associated with farm inputs and with production.

6.50 Obviously, in holdings where livestock is more important than land, numbers of livestock (type depending on the country) is a good measure of size of operations.

6.51 A particular consideration is needed for the tables presenting input of labour (See Vol.1, §10.21). Apart from the usual tabulation of number of workers by main classification variables, information on total labour input requires aggregation of the total working time by all workers on the holding (household and non-household members working on the holding, permanent and temporary workers). Such aggregation implies the need to convert categorical data (classes of working time) into continuous data. There are various ways to do such conversion. For example, one option would be to use the measure of “annual work unit”. The value of “1” (or “100 %”) in this case the work is performed by one person working on the holding on a fulltime basis and this is the maximum value for 1 person. Then, other options (full-time work during less than whole agricultural year, and part-time worked) can be converted using an appropriate coefficient (a ratio between the amount of work performed and the full annual work unit) for each person working on the holding. The values for all persons working on the holdings are then aggregated accordingly to obtain the labour input for this holding measured in annual work units.

6.52 As relevant to national circumstances, it is recommended that the number of persons who worked on the holding during the census reference year (i.e. the number of household members of working age who worked on the holding in paid or unpaid work), as well as working time of such persons, be cross-tabulated according to whether the work is in employment or in own-use production work and also by sex (for details see Vol.1, paragraph 8.9.26).

6.53 Classification by purpose of production is intended to show the extent to which agricultural holdings are participating in the market economy. Similarly, classification by land tenure and by legal status of the holder is intended to make possible the comparison of data between land owners and tenants, and between holdings in the household sector and holdings belonging to the non-household sector (i.e. cooperatives, state farms, corporations, etc.).

6.54 Classification by age and sex of holder makes it possible to evaluate the effect of these two factors on farm productivity, adaptability of holders to new technology, etc.

6.55 Irrigation is an important concern in countries where there are competing needs for water resources and increased agricultural production is dependent on irrigation.

Limitations regarding tabulation of census results due to sampling and when presenting data for small area units.

6.56 If sampling is used in some stage of census enumeration either in the classical, the modular approach (supplementary modules by sampling) or the integrated census/survey modality, census estimates based on a small number of holdings would have unacceptable high sampling errors for a range of characteristics. Therefore, it imposes limitations to tables related to such characteristics to be reported. The tabulations prepared for the lower levels of administrative units would have to be very limited. The tabulations to be produced for the lowest administrative level would depend on the sampling scheme, sampling variance of characteristics and level of reliability desired. In particular, detailed tabulations of rare items such as minor crops are to be avoided. As a rule of thumb, all tables with a large number of empty cells (when populated with data) are to be avoided. Information about sampling errors should be provided systematically for published tables (perhaps, as a footnote); a special chapter may also be included in the reports to describe the effects of sampling on the results.

6.57 A study either based on past census results or on more recent surveys, would provide a reasonable estimate of the sampling error of major holding characteristics. These would serve as a guide in deciding which tabulations might be prepared for various administrative levels at a desired level of reliability.

6.58 Some cross tabulations may only be possible when data are collected at the same time, i.e. commonly in a classical census. There are limitations in terms of cross tabulation between variables in the core and those in the supplementary module(s) in a modular census when conducted separately. These limitations refer also to cross tabulation between variables contained in different data collections when using the integrated census-survey modality (i.e. in core and thematic modules).

6.59 Even in a complete enumeration census, there may be some limitations when presenting geographic data as information for small areas may not be representative in countries with many (especially large) holdings spread across several areas. An agricultural holding may have parcels in more than one village or district, sharing the same production means. In such cases, when the agricultural activity of the holding is operated across different administrative or geographical units the location of parcels (and livestock as well) could differ from the main location of the holding. This is the case when all data on holdings are attributed to the main location of the holding, distorting the information on geographic and administrative areas, if this problem has not been addressed when designing census methodology and census questionnaire (see Chapter 14, paragraph 14.50 and the Vol. 1, paragraph 6.12)

Some examples

Examples of type of tables and a country example are presented here. In the next sub-section actual country practices are also given.

Example 1 (a two-way table):

Table XX. Number of holdings by administrative district and by age of agricultural holder

Legal status of holder	TOTAL	Administrative district (AD)			
		AD#1	AD#2	AD#3
Total agricultural holdings					
<i>of which by age of holder:</i>					
Holder is a civil person:					
- under 25 years					

- 25 – 34 years					
- 35 – 44 years					
- 45 – 54 years					
- 55 – 64 years					
- 65 years and over					
Joint holders					

Example 2 (a three-way table):

Table XX. Number of holdings by administrative district, by sex of holder and by classes of total area

Sex of holder /Size class of total area	TOTAL	Administrative district (AD)			
		AD#1	AD#2	AD#3
Total					
Holdings without land					
Holdings with land:					
- Less than 1 ha					
- 1 – 1.99 ha					
- 2 – 4.99 ha					
....					
Male					
- Holdings without land					
- Holdings with land:					
- Less than 1 ha					
- 1 – 1.99 ha					
- 2 – 4.99 ha					
....					
Female					
- Holdings without land					
- Holdings with land:					
- Less than 1 ha					
- 1 – 1.99 ha					
- 2 – 4.99 ha					
....					

Example 3 (two-way table at community-level):

Table XX. Number of communities by usual way to access the nearest urban centre by agro-ecological zone

Usual way to access the nearest urban centre	TOTAL	Agro-ecological zone (AEZ)			
		AEZ#1	AEZ#2	AEZ#3
Year round motorable road					
Seasonal access by motorable road					
By water (river)					

By water (sea)					
.....					

Example 4 (cross-tabulations of community-level items with holding-level items):

Table XX. Number of holdings in communities with some agricultural service by type of service and by main purpose of production

Type of infrastructure/ agricultural service in the community	Total number of holdings	Main purpose of production	
		Producing mainly for own consumption	Producing mainly for sale
Access to urban centre			
Presence of a periodic or permanent agricultural produce market			
Whether the community is covered by the agricultural produce collection network			
Presence of food storage facilities			
Presence of agricultural processing facilities			
Presence of a seed dealer			
Presence of a pesticides dealer			
Presence of a fertilizer dealer			
Presence of irrigation facilities			
Access to veterinary services			
Presence of credit institutions			

Box 6.1 Country examples: Saint Lucia

2007 Saint Lucia Agricultural Census. The tabulation plan introduced two aspects that were very useful for users:

1. A first table depicting the main characteristics of the agricultural sector from census data (by administrative district):
 - ◆ Total Household members in holdings
 - ◆ Average Size of Holder's Household
 - ◆ Number of Holdings (Landless included)
 - ◆ Number of Holdings with Land
 - ◆ Total Holding Area (acres)
 - ◆ Average Size of Holdings (acres)
 - ◆ Number of Female Holders (Individual Holdings)
 - ◆ Number of Male Holders (Individual Holdings)
 - ◆ Median Age of Female Holders (Individual Holders)
 - ◆ Median Age of Male Holders (Individual Holders)
 - ◆ Number of Parcels
 - ◆ Average Number of Parcels per Holding
 - ◆ Number of Holdings with Agricultural Land
 - ◆ Total Agricultural Land (acres)
 - ◆ Average Agricultural Area per Holding with Agricultural Land
 - ◆ Number of Holdings with Cropland Area
 - ◆ Total Cropland Area
 - ◆ Average Cropland Area per Holding with Cropland
2. A classification of tables according to the main classification variable.
 - ◆ A. Tables – General Tables at Administrative District Level (58 tables)
 - ◆ B. Tables – Cross Tables at National Level:
 - B1 - Main Classification Criterion: Total Holding Area and Agricultural Area (44 tables);
 - B2 - Main Classification Criterion: Cropland (12 tables) ;
 - B3 - Main Classification Criterion: Number of Permanent Workers (54 tables);
 - B4 - Main Classification Criterion: Land Tenure (6 tables);
 - B5 - Main Classification Criterion: Legal Status (4 tables);
 - B6 - Main Classification Criterion: Size of Holder's Household (2 tables);
 - B7 - Main Classification Criterion: Sex and Age of Holder (8 tables)

Country examples: Australia, Brazil, China, France, Republic of Congo, Russia, USA -Links

CHAPTER 7 QUALITY ASSURANCE FRAMEWORK FOR CONDUCTING A CENSUS OF AGRICULTURE

This Chapter presents various quality issues related to census taking and outlines a quality assurance management framework, including comments on each dimension of quality as they relate to census phases. Finally, an overview of some quality control techniques is presented followed by discussion of techniques and implementation for a number of specific activities in census taking.

Introduction

7.1 Every statistical organization needs to have a quality management system (or equivalent) in place to ensure quality in processes and outputs, as well as in institutional aspects. A systematic quality management typically takes the form of a quality assurance framework⁴¹.

7.2 The quality assurance framework aims at achieving an appropriate balance between the 'evolving needs of clients, costs, respondent burden, and the various dimensions of quality' (Statistics Canada's Quality Assurance Framework, 2002). The concept of quality of statistics has many dimensions and according to (Benedetti and al, 2010 p 268) 'the modern approach is user-oriented, while the earliest measures of statistical quality were producer-oriented'. Therefore, the modern concept of quality put the emphasis on user needs and satisfaction (or fitness to use) as opposed to quality being only associated with accuracy which focuses more on errors (sampling and non-sampling). Even if this aspect is still important, there are other important dimensions to take into account when considering the quality of statistical data (or output). For example, even if statistical data are accurate, they do not have sufficient quality if they are produced so late that they are no longer relevant for the user or if they cannot be easily accessed, or conflict with other credible data, or are too costly to produce.

7.3 The number of dimensions of statistical data quality vary across the institutions and (FAO 2014) recommends the followi five dimensions::

- ◆ **Relevance** : the degree to which statistics (e.g. census items collected) meet users' needs, implying the need to avoid production of irrelevant data, namely, data for which no use will be found.
- ◆ **Accuracy and reliability**: closeness of the estimated value to the (unknown) true value
- ◆ **Timeliness and punctuality in disseminating results**: time elapsed between release of data and reference period and degree to which pre-announced release dates are met.
- ◆ .
- ◆ **Coherence and comparability of statistics**: degree to which data from a single statistical programme, and data brought together across statistical programmes, are logically connected and degree to which statistics are comparable over space (between countries and regions) and time (between different time periods);
- ◆ **Accessibility and Clarity/ Interpretability**: ease with which statistical data can be obtained by users and degree to which statistics are understandable for non-expert users⁴² and availability of information describing sources, definitions and methods.

Given the specific importance of accessibility and clarity and interpretability in the context of censuses (Population or Agricultural Census), these 2 dimensions are discussed separately in the remaining paras of this chapter as they apply to different aspects of the census operation.

⁴¹ United Nations Statistics Division (2012): Guidelines for the template for a generic national quality assurance framework (NQAF) – available at <http://unstats.un.org/unsd/dnss/docs-nqaf/GUIDELINES%208%20Feb%202012.pdf>, pag.

5

⁴² Principles and Recommendations for Population and Housing, Censuses rev 3: the 2020 Round, 2015, para 2.175

7.4 Quality is also a relative rather than an absolute concept from the user perspective. For example, for a researcher, *accuracy* may be the most important aspect while for a decision maker, it may be *timeliness*. Another aspect not often mentioned is the cost or value for money associated with some dimensions of quality. This aspect is particularly important in developing countries with limited resources. The sections below will focus mainly on six dimensions listed above.

7.5 In the context of the census of agriculture, some attributes of quality may be emphasized over the rest. A census of Agriculture like the Population and Housing Census is a particularly expensive exercise to undertake and it creates a burden both on the statistical resources and respondents. Therefore, it is essential to ensure that the census addresses as much as possible effective data needs. It is therefore crucial to consult with users of census data in the earliest stages in designing the census process for determining the demand for potential census topics. Quality management of a census of agriculture should be comprehensive and should cover all activities including planning, development, data collection, processing, evaluation and dissemination of census results.

Quality assurance plan for the census of agriculture

7.6 It is recognized that the quality of statistical data is the result of processes, and deficiencies in data quality are usually the result of deficiencies in process rather than the actions of individuals working in that process. Therefore, the key to quality assurance and improvement is to be able to regularly measure the timeliness and accuracy and reliability of a given process so that the process can be improved when deficiencies are detected.

7.7 Quality assurance is therefore a process ensuring that quality goals are consistently met throughout the whole system of data production. The major goal of quality assurance programme for the Census of Agriculture is to prevent and minimize potential errors at design stage and detect errors as soon as possible so that timely remedial actions can be taken even as the census operations continue. The focus should be to prevent errors from reoccurring, to detect errors easily and inform the concerned staff so that corrective actions are taken in time and errors are not repeated. Without such a programme, the census data may contain many errors which can severely diminish the usefulness of the results. Therefore, a quality assurance programme should also be viewed as a quality improvement programme and should be developed as part of the overall census plan, and integrated with other census plans, schedules and procedures.

7.8 Traditional quality assurance and control was based on postfactum correction of errors after the event, whereas the emphasis of the modern quality assurance programme focuses on improving the process that caused the “error”, which may be any of the timeliness or accuracy attributes falling below specified levels.

7.9 The management of quality is not the maximization of quality at all costs, but the achievement of an appropriate balance between the quantity and quality of information yielded and the resources available.

7.10 The modern approach to quality assurance is based on process control in which quality assurance is planned and integrated in each step of the census process. An effective agricultural census quality assurance program should have the following attributes:

- ◆ A well designed system or procedure (which maximizes quality and efficiency);
- ◆ An effective training program;
- ◆ A quality control program to ensure the desired level of quality during the course of the census operation;
- ◆ An evaluation program to measure the accuracy of the census operation and identify areas where future improvements may be made.

7.11 Since people play a key role in most census processes, they are in a good position to identify problems with quality and provide solutions. Quality is therefore not just the outcome of mechanistic applications of predetermined measures but relies on a combination of:

- ◆ Established, documented processes;
- ◆ Systems to monitor the outcomes of these processes;
- ◆ Active encouragement by management to involve staff undertaking the processes in identifying and resolving deficiencies with quality.

7.12 This may be accomplished by:

- ◆ Setting standards and using data to improve the process;
- ◆ Ensuring a better understanding of the overall process by the census staff and their involvement at all phases;
- ◆ Including quality issues in training programmes;
- ◆ Quality feedback for each census process for on the spot operational changes when necessary

Managing dimensions of quality during the different phases of a census

Relevance

7.13 This quality dimension is one of the most important elements for the census of agriculture. The census being a major and costly data collection exercise, it is essential that it focuses on the most important needs of users. Experience shows that this can be challenging since there is a wide variety of users and prioritizing their needs is not always easy. Processes that can be considered include: client and stakeholder feedback mechanisms; review of past census programme and data analysis. Information from these processes can then be used to ensure the relevance of census content and outputs.

7.14 Important feedback mechanisms might include consultations with key government departments and agencies, including user/producer workshop, advice from professional advisory committees in major subject matter areas; consultations with interested groups such as farmers associations, crop boards; and review of experiences from other countries. (see Chapter 14).

7.15 All these consultations should lead to better defining the scope of the census and identifying topics or data items that are not suitable for the census but can be covered through other data collection methods or from other sources in an integrated agricultural statistics system (e.g. surveys or registers). The outcome of this process should be an input to defining the content of census questionnaires and modalities of collection (see Chapter 8).

Accuracy

7.16 Accuracy measures the closeness between an estimated result and the (*unknown*) *true value*. It is an important quality attribute for the credibility and usefulness of the agricultural census results. The management of accuracy of census results 'requires attention during three key stages of the census process: *design, implementation and evaluation*'.

Design

7.17 The accuracy of census data depends largely on the methods used and the quality assurance processes to identify and control potential errors at the various stages of the census.

7.18 The following eight key aspects of design (adapted from Statcan 2002 and UNECE, 2006) are considered critical and must be taken into account in every census to ensure that accuracy concerns are given appropriate attention:

- ◆ **Overall trade-offs:** The census is always conducted with a certain budget and trade offs are

needed between accuracy, cost, timeliness and respondent burden;

- ◆ **Focus the census on data that are most suited for this operation:** The WCA 2020 emphasizes the need to consider the census within an integrated census/survey programme and foresees various modalities of collecting the required data in the most cost effective way, depending on country condition. Explicit consideration should be given to alternative sources of data, including the availability of existing survey data or administrative records, to minimize new data collection.
- ◆ **Adequate justification** for each question asked and **appropriate pre-testing** of questions and questionnaires in each mode of collection. It is essential to respond to agreed data requirement while keeping the questionnaires as short as possible;
- ◆ **Adequate frame:** As discussed in Chapter 12, 'a prerequisite for the organisation of an agricultural census, whatever the modality of implementation is the preparation of suitable frames'. A key aspect that must be assessed is the coverage of the target population;
- ◆ **Sound sampling and estimation methods:** Depending on the census modality, sampling may be used at different phases of the census as discussed in Chapter 13. In any case, careful consideration must be given to the size and design of the sample and to the weighting and other estimation procedures needed. It is important that a sampling expert with experience with the use of sampling for agricultural census deals with this aspect;
- ◆ **Adequate methods for accurate responses:** In formulating the questions and defining the method to obtain the data (interview or objective measurement), care should be taken to ensure that measures are in place for facilitating and ensuring accurate responses. Also measures should be taken to minimize non-response and dealing with missing data;
- ◆ **Quality control at all stages:** Proper consideration should be given to ensure that mechanisms are in place for quality control and other quality assurance processes for all stages of data collection and processing; and
- ◆ **Appropriate internal and external consistency checking** of data.

7.19 It is also important to allocate **sufficient time and resources to the planning and design phase** of the census. Experience shows that badly designed census and implementation without enough time devoted to the design phase can lead to delays in the field, bad quality data and waste of resources. In particular, time and resources should be set aside for properly testing all key elements of the census, including all aspects of the methodology and organization of the census, during a pilot census preferably one year before the census (see Chapter 17).

7.20 This WCA 2020 census programme strongly encourages the use of new technologies and innovations to improve quality and efficiency. However they must be adequately tested to minimize risk. Questionnaires, in particular, must be tested to ensure that respondents can and will be willing to provide data of acceptable quality. The design should include mechanisms to monitor quality, to react effectively to unanticipated problems and to be able to verify or support the credibility of the results, as well as to understand their limitations.

Implementation

7.21 Even a well designed census can result in bad quality data, if it is not properly implemented. The results of implementation depend not only on the specific design, but also on the instruments of implementation. These instruments will include the resource and material plans, the supervisory structure, the schedules, the operations, procedures and checks, the training, the publicity, etc., developed and specified during the design phase (Statcan 2002).

7.22 As indicated in StatCan, 2002, it is highly recommended to establish a comprehensive monitoring mechanism at the stage of census design. This will facilitate collecting information which is needed to monitor and correct problems arising during implementation. This requires a timely information system that provides census managers with the information they need to adjust

or correct problems while work is in progress. Information is also needed to assess whether the design was carried out as planned, identify problem areas and lessons learned from census operations to aid design for future censuses.

7.23 (StaCan 2002) provides some examples of activities that could be undertaken to manage and monitor accuracy during implementation and operations:

- ◆ Regular reporting and analysis of response rates and completion rates during collection;
- ◆ Monitoring non-response follow-up rates;
- ◆ Monitoring interviewer feedback;
- ◆ Monitoring coverage checks and controls;
- ◆ Monitoring of edit failure rates and the progress of corrective actions;
- ◆ Monitoring of results of quality control procedures during collection and processing;
- ◆ Monitoring of expenditures against progress; and
- ◆ Development, implementation and monitoring of contingency plans.

7.24 The increasing use of new technology (Remote sensing images, GPS, GIS, etc.) facilitate the collection of required monitoring information and its transfer to managers in almost real time. This should facilitate and improve substantially the monitoring of field operations (see Chapter 17 & 18).

7.25 An important issue faced in several censuses is related to the timing of the implementation of field operations. A specificity of the census of agriculture is that it is highly dependent on the agricultural and cropping calendar. The planning of the census field operation must take into account the agricultural seasons in the country. Some countries may have more than one cropping season and field operations may be better carried out at certain periods of the year due to operational reasons (transportation, heavy rains, etc.). Delays of few months may mean postponing the census taking for another year.

7.26 Another issue related to timing is the possible overlap between the calendar for political elections and the implementation of the census. Census managers should take into account the calendar of political election when planning for the census. It is recommended to keep the implementation of the census operation far from any important political election to ensure the integrity of the operation and avoid confusions that may affect the collaboration with respondents and the quality of data.

Quality evaluation

7.27 For the credibility of census results, it is important to provide an evaluation of the level of accuracy to users. In order to be able to do so, evaluation of accuracy needs to be considered at the design phase since the measurement of accuracy often requires information to be recorded once census data collection and processing is under way.

7.28 The overall accuracy of census results depends on many factors at various stages of the census collection, processing and estimation. According to (UNECE, 2006, adapted), primary areas of evaluation include the following:

- ◆ Evaluation of coverage error, both under-coverage and over-coverage and response errors. In most countries this is done via post-enumeration survey (see Chapter 22);
- ◆ Non-response rates and imputation rates;
- ◆ Data capture error rates, coding error rates;
- ◆ Measures of sampling error, when sampling is used. Standard errors, or coefficients of variation, should be provided for key estimates. Methods of deriving or approximating standard errors should be indicated for estimates not provided with explicit standard errors.
- ◆ Any other serious accuracy or consistency problems with the results. This relates closely to coherence and allows for the possibility that problems were experienced with a

particular aspect of the census resulting in a need for caution in using results.

Timeliness and punctuality

7.29 One of the major challenges of agricultural census organizers is to produce the results in a timely manner and according to the plans. Timeliness should be considered at design phase often based on trade-offs with accuracy and relevance. Timeliness is also directly affected by fundamental time requirements to collect and process census data with an adequate degree of quality in the other dimensions.

7.30 There are countries that have experienced delays of 2 or even 3 years for releasing results after field work is completed. This reduces the usefulness, credibility and relevance of the census and is often due to not paying enough attention and allocating enough resources to activities beyond the data collection phase. It is therefore highly recommended to dedicate sufficient effort and resources to the activities following field data collection. A good practice could be to have dedicated teams working in parallel on various aspects of the census, including processing, tabulation, analysis and dissemination. These teams should be allocated adequate staff and resources from the beginning of the census preparation. Regarding data processing, the increasing use of new technology, in particular CAPI and other electronic data capture methods should significantly reduce processing time and improve the timeliness of census results in the future. It should be noted that accuracy of the census data cannot be significantly improved at data processing stage. Therefore the process of data editing to correct apparently inconsistent or inaccurate census data should not lead to developing highly complex procedures that may introduce other errors and impose heavy costs in terms of delay in release of the data and cost with no real improvement in the accuracy.

Rolling Estimates (experience from STATCAN)

One of the solutions to improving timeliness of the release of the statistical information in Canada relies on an approach called Rolling Estimates (now used for more than 100 business surveys) and under serious consideration for the Census of Agriculture 2021. Under this approach, collection, processing and analysis are totally integrated and conducted simultaneously.

Under this approach, a complete set of estimates and quality indicators are produced at various intervals from integrated collected and administrative data as they become available and imputed data for non-response. The quality of the estimates is compared with pre-determined quality targets. Units are assigned scores measuring their global impact on the quality of the estimates. Only units that are going to significantly contribute to improving the quality of domain estimates that have a quality below target are eligible to be followed-up for non response and failed edits. The process is entirely automated. Priorities are re-assigned after every iteration. Certification of the survey results can begin as soon as the quality targets are reached for some domains.

This is a very different way of processing and editing data from the traditional sequential approach that consists of vetting the data after each stage of the survey cycle.

Dash Board

7.31 It is important to manage expectations of users by announcing well in advance the major information release dates. This helps users plan and provides internal discipline in working towards these important dates. Release of preliminary data followed by revised and final figures can be a strategy to consider for making data timelier.

Accessibility

7.32 The large amount of resources spent on the census can only be justified if its results are used for making evidence based decisions. Information that cannot be accessed is of no value to users. Therefore, all measures should be taken to ensure that Census information is readily accessible to users. Chapter 23 discusses reporting and data dissemination policies for the census.

Also chapters 20 and 21 discuss data archiving and easy access to micro-data.

7.33 Nowadays, Internet has the potential to play an important role as the primary dissemination vehicle. Online dissemination should include not only the data released but also information about the data (metadata) such as data quality statements and descriptions of the concepts and methods used.

Coherence and comparability

7.34 The objectives for coherence of census data include: internal coherence of census data between various questionnaires or sections; coherence with data and information from prior censuses; coherence with other relevant statistical information from other sources such as periodic surveys or registers; coherence with similar data from reliable administrative sources; coherence with information from similar censuses of other countries.

7.35 In order to ensure internal coherence, it is important to develop and use the same standard frameworks, concepts, variables, classifications and nomenclature for all subject matters that are measured in the various modules and phases of the census. This will also ensure measurement is standard across different sources and, for international standards, between countries.

7.36 **International comparability** is also an important dimension of census quality enabling international comparisons. The use of international standards on census concepts, methodology, classifications, but also of the main variables and classes for the tabulation of census results, units of measurement are recommended to be strictly applied by countries

7.37 Finally, validation, evaluation and analysis of census data that focuses on the comparison and integration of information from the census and other sources will highlight the degree to which quality is achieved in coherence. The census data should be analyzed for domains and aggregations, both large and small that are considered important. Such analysis should consider totals, distributions, relations between variables or sets of variables, relations between domains, growth rates, etc. as appropriate. Comparisons should be made to data from prior censuses and to comparable survey data. The analysis should be done with some reference to planned tabulations. The confrontation of census data and data from different sources, and their subsequent reconciliation or explanation of differences, is an activity that is recommended as discussed in Chapter 24. The reconciliation of census results, with existing and past data can lead to revision of main statistical series in order to make them consistent/comparable over time and can result in revision of production data and even of National Accounts' estimates. More information on reconciliation can be found in Chapter 24.

Clarity and Interpretability

7.38 Interpretability is mainly concerned with providing metadata or information needed by users to understand census data (see Chapters 21 and 23). Three aspects are important: (i) the concepts and classifications that underlie the data; (ii) the methods used to collect and process the data; and (iii) measures of data quality. These three aspects cover what has been measured, how it was measured, and how well it was measured. Providing comments in the media with key messages of census information as it is released increases the chance of clarity and correct interpretation at the public level.

Quality control techniques

7.39 Census quality assurance programme involves a wide variety of mechanisms and processes at various levels throughout the census programme. An important technique applicable in many census operations is statistical quality control which primarily addresses accuracy. The brief outline

of quality control techniques below are mainly taken from (UNECE, 2006)⁴³

7.40 It is indicated that the success of any quality control and improvement programme depends on: (i) defining quality standards or requirements; (ii) determining appropriate verification techniques; (iii) measuring quality; and (iv) providing for timely feedback from the results of the programme so that effective corrective action may be taken.

7.41 The main techniques used for the census are complete verification (or 100%) , Sample verification, or spot checks. These techniques can be applied during data collection and also at data processing phase.

- ◆ Complete verification theoretically assures a complete check of the work. However, verifying all items can be time consuming and very costly. In many operations, complete verification is only used as the operation is starting up. Once it is shown that the quality is meeting the required standard, sample verification procedures may be implemented. Usually, this transition is managed on an employee-by-employee basis. At data collection phase of the census, complete verification of all the questionnaires completed by each enumerator may be performed at the beginning of the operation to ensure that the quality is meeting the requirements or identify issues with the questionnaire or with some enumerators in order to address them in time. This may involve revisiting holdings surveyed by the enumerator. Once there is confidence that all enumerators are meeting the standard, sample verifications involving holdings visit may be considered.
- ◆ Sample verification: reduces the cost and can yield results almost as reliable as 100% verification. To be effective the sample must be selected on a scientific basis using probability sampling. It will be designed on the basis of the expected or observed error rates of enumerators, the outgoing quality to be achieved, the cost of the operation in question and the cost of operating the quality control plan. It will be adaptable to adjust as the quality of work may change. For example, as outgoing quality improves then a reduced rate of quality control sampling may be suitable. Two types of procedures can be considered: acceptance sampling and statistical process control
 - Acceptance sampling is a quality control technique that establishes a sample design and decision rules to determine which batches are acceptable or unacceptable and is usually used in jobs like manual editing, coding, and key entry data capture where work is assembled in lots or batches.
 - Statistical process control is a methodology to ensure that such processes stay in control and to provide feedback for corrective action when not in control. Census operations where this may be applicable include: the printing of forms; automated data capture via intelligent character recognition (ICR) or optical mark recognition (OMR); and the scanning of forms for ICR/OMR.

7.42 Post enumeration surveys are also aimed to assess the quality of the census results. For more discussion on PES see Chapter 20.

Implementing a quality assurance and improvement programme

7.43 Quality assurance is a process ensuring that quality goals are consistently met throughout

⁴³ (UNECE, 2006) also refers to standard textbooks such as Duncan (1986), Hald (1981) or Schilling (1982). (Duncan, A.J. 1986. *Quality Control and Industrial Statistics*. Fifth edition. R.D. Irwin Inc., Illinois; Hald, A. 1981. *Statistical Theory of Sampling Inspection by Attributes*. Academic Press, New York.; Schilling, for example 1982. *Acceptance Sampling in Quality Control*. Marcel Dekker, New York.)

the whole system of data production. Therefore, the programme of quality assurance needs to be implemented in an integrated fashion throughout the design, development and execution of the steps in the census process.(UNECE 2006) provides examples, of quality assurance approaches applicable to a number of census steps.

7.44 *Census questionnaire(s)*: Their elaboration should take into account the statistical requirements of the data users, as well as logistical aspects for data collection and requirements for data processing. Issues and recommendations related to development of the census questionnaires are discussed in Chapter 14. To ensure quality assurance at this stage, emphasis is on testing to ensure that questionnaires can be applied properly for all applicable methods. Qualitative testing is required to check possible issues and should cover an adequate variety of situations that may be encountered in the field. Agricultural conditions may vary from one region to another and from one segment of the population to another. Qualitative tests and cognitive interviews should be planned to ensure that questions and concepts are clear and properly understood. In some countries translation issues may have an important impact on quality and should be properly addressed when designing the questionnaires and manuals.

7.45 A particular challenge in questionnaire design is to design the questionnaire to be respondent friendly while at the same time, meeting requirements for subsequent processing steps, especially for data capture and coding operations. The testing program must also ensure that these features are thoroughly tested prior to questionnaire finalization.

7.46 *Coverage* is a critical element of accuracy as it has an impact on the quality of all data produced by the census. Thus the coverage concerns should be taken into consideration in the design and implementation of most census activities and their quality assurance programmes. Issues to consider (UNECE 2006) include:

- ◆ Careful definition and mapping of Enumeration area boundaries to ensure no area is omitted or included twice.
- ◆ Clear instructions and training on coverage for staff engaged in listing and enumeration must be clear, explicit and easy to understand. The target population must be well defined and related instructions and questions for both interviewers and respondents need to be carefully developed and thoroughly tested.
- ◆ Processing procedures should be developed with a view to minimizing the risk of erroneously cancelling, losing or artificially creating holdings.
- ◆ Appropriate training, supervisory checks and quality assurance approaches during operations will help minimize coverage error.

7.47 Despite all the measures taken, some coverage error is unavoidable and it is important to measure, analyze and report on coverage error. This is best done via an independent post-census enumeration survey (see Chapter 20).

Box 7.1: Canada 2001 – Reduction and estimation of under-coverage

The Census of Agriculture was conducted in conjunction with the Census of Population. The Census of Agriculture questionnaire was dropped off along with a Census of Population questionnaire when someone in the household was a holder. In order to reduce and estimate possible under-coverage, two follow-up surveys were conducted in Canada.

The first one, Farm coverage Follow-up Survey (FCFS), was aimed at increasing large holdings coverage. It identified all large holdings in each province on Statistics Canada's Farm Register that may have been missed by the Census of Agriculture. The holders of these farms were contacted and those that had been missed completed their questionnaires over the telephone.

The second one, Coverage Evaluation Survey (CES), was aimed at estimating the coverage of the Census of Agriculture. It selected a random sample of smaller holdings from Statistics Canada's Farm Register for which no questionnaire was received. The survey used a short questionnaire to collect key information about the operating status and the size of the holding. The CES estimated the overall under-coverage rate as being 5.6%.

7.48 *Enumeration*, whether by face to face interviewing or by other data collection methods (see Chapter 18) is usually done by allocating an enumeration area to one enumerator. He/she will be required to implement a number of quality checks on his/her own work. His/her supervisor will implement quality control procedures using for example acceptance sampling procedures, to ensure the quality of various aspects of the enumerators' work.

Box 7.2: Quality assurance during field work

Saint Vincent and the Grenadines 2000

A quality Control Team (QCT) was created at the Agricultural Census Unit of the Ministry of Agriculture and Labour. The team travelled throughout the country in coordination with the Regional Extension Supervisors to check the work of the enumerators and supervisors. Supervisors were asked to collect samples of questionnaires from the enumerators and submit them to the QCT for checking. Re-interviews were conducted in randomly selected holdings to confirm that they were visited and the information was properly recorded.

Lebanon 1998-99

Special teams consisting of supervisors and controllers were assigned to complete control questionnaires for a random sample of the enumerated holdings. The sample was drawn in parallel to the advancement of the enumeration process. In total 2.5 percent of the questionnaires were checked.

After the questionnaires were validated by the field team (controllers and supervisors), the ultimate checking was carried out by the central team. The checking procedure involved the cross-inspection of the content of the census questionnaires, the control questionnaires and the village questionnaires as well as comparisons with other available information sources. In some cases it became necessary to contact the holder by telephone to verify the data or to re-visit the holder in order to resolve inconsistencies.

Source: WCA 2000 Methodological review

7.49 *Data processing* is one of the crucial steps by which raw census data collected in the field are converted into a complete edited electronic master file to be used for tabulations. This may involve data coding and data entry (or direct data capture when CAPI or CASI data collection is used). It may involve also editing and imputation. New errors can occur in any of these operations and all three types of quality control techniques discussed above can be useful.

7.50 Most data entry packages now have routines built into the data entry software to perform several checks in order to minimize errors at this stage, including, range checks and certain consistency checks. When a potential error is identified the data entry clerk can be required to re-key the field. When using CAPI, many of these checks can be performed at field level. In data capture operations involving scanning of questionnaires and data capture via ICR/OCR, quality control procedures will be necessary as well, including quality control of the scanning equipment. Manual editing and coding, including computer-assisted methods, should be thoroughly verified by another set of personnel.

7.51 More detailed information are provided in Chapter 19 on data processing.

Country examples of quality management:

- ◆ THE SCOTTISH GOVERNMENT, Results from June Agricultural Census, 2014:
<http://www.gov.scot/Publications/2014/10/6277/4>
- ◆ AUSTRALIA: Agricultural census 2000/2001:
<http://www.nss.gov.au/nss/home.NSF/0/7823AE5F401BDF1FCA25691500155667?OpenDocument>

References and suggested reading

1. EUROSTAT Quality Assurance Framework, Based on ESS QAF V1.1, Author Unit B1, June 2013

2. **FAO**, (Zarkovitch), Quality of statistical data, 1966
3. The **FAO** Statistics Quality Assurance Framework, 2014
<http://www.fao.org/docrep/019/i3664e/i3664e.pdf>
- 4.
5. **FAO** World Programme for Census of Agriculture 2020, Volume 1, 2015
6. **FAO** World Census of Agriculture 2000 Methodological Review
7. **Roberto Benedetti** Agricultural survey methods, 2010
8. **Statistics Canada's** Quality Assurance Framework, 2002
9. **United Nations**, Principles and Recommendations for Population and Housing, Censuses rev 3: the 2020 Round, 2015
http://unstats.un.org/unsd/demographic/meetings/egm/NewYork/2014/P&R_Revision3.pdf
10. **United Nations Statistics Division** (2012): Guidelines for the template for a generic national quality assurance framework (NQAF) – available at <http://unstats.un.org/unsd/dnss/docs-nqaf/GUIDELINES%208%20Feb%202012.pdf>
11. **United Nations Economic Commission for Europe**: Conference of European Statisticians Recommendations for the 2010 Censuses of Population and Housing, New York and Geneva, 2006

DRAFT

PART TWO Census modalities

CHAPTER 8: GENERAL OVERVIEW OF COMMON RECOMMENDATIONS FOR CENSUS MODALITIES

The census of agriculture can be carried out using different approaches and in various ways, depending on available resources and national conditions. The WCA 2020 volume 1 discusses four possible approaches and modalities for conducting a census of agriculture, i.e.: (i) *classical approach* (ii) *modular approach*, (iii) *the integrated census and survey programme modality* and (iv) use of registers as a source of census data. However, regardless of the census approach or modality, there are issues and considerations that are common and need to be taken into account. This chapter discusses the common issues for conducting a census whatever the approach or modality. It will be followed by three chapters that presents the four approaches and modalities for implementing a census and provides guidelines to countries on how to select and implement the approach or modality most suitable for the country, taking into account technological and methodological innovations and practical experiences in other countries. They describe the necessary conditions for using each census approach or modality and its advantages, disadvantages and requirements for census taking.

Introduction

8.1 A census of agriculture is defined in WCA 2020 Volume 1⁴⁴ as “a statistical operation for collecting, processing and disseminating data on the structure of agriculture, covering the whole or a significant part of a country”. Its basic objectives are:

- ◆ To provide **data on the structure of agriculture, especially for small administrative units**, rare events and to enable detailed cross-tabulations;
- ◆ To provide **data to use as benchmarks** for and reconciliation of current agricultural statistics;
- ◆ To provide **frames for agricultural sample surveys**.

8.2 The WCA 2020 recognizes that the main objectives of a census of agriculture can be achieved using different approaches and modalities depending on country statistical capacity, national preferences and the availability of resources and data sources. The WCA 2020, Volume 1 presents four approaches and modalities for conducting a census of agriculture, i.e.: (i) classical approach (ii) modular approach, (iii) integrated census and survey modality and (iv) use registers as a sources of census data.

8.3 This chapter elaborates on these census modalities, as well as on the ways and steps for their implementation taking into account technological and methodological innovations and practical experiences in countries. It discusses the main advantages, disadvantages and requirements for each approach or modality.

8.4 However, it should be noted that in practice, there is not always a clear distinction between the approaches or modalities and instead features pertaining to one approach or modality may

⁴⁴ FAO (2015). World Programme for the Census of Agriculture 2020. Volume 1: Programme, Concepts and Definitions. SDS 15, paragraph 1.7

have to be adopted when conducting another modality. Therefore, censuses that are conducted in countries will be often assimilated to an approach or modality when their dominant features are those of that modality.

8.5 A study done by FAO Statistics Division in 2015 on the implementation of the WCA round 2010 showed that most countries continue using the classical census approach, while at the same time, it is anticipated that in the upcoming censuses more and more countries would use alternative census approaches or modalities. There are important reasons for implementing alternative approaches, such as: (i) budget limitation for census taking, (ii) need to produce more frequent and timely agricultural statistics, (iii) fast growing digital and mobile technology; (iv) increasing availability and access to data from administrative sources and technical capacities to handle such data; (iv) reluctance of some population groups to participate in the census and need to reduce respondent burden. The growing demand for more data and at the same time the scarcity of resources for census taking create new challenges for ensuring that the census is conducted in the most cost-effective way.

8.6 The main distinguishable features of the four modalities in the framework of WCA 2020 are briefly presented below.

8.7 In a *classical census approach*, enumeration is commonly conducted in a one-off operation, providing a snapshot of the entire population at a specified period.

8.8 The *modular census* approach consist of a clear distinguishable core module to be conducted on a complete enumeration basis and one or more supplementary modules to be conducted on sample basis only once simultaneously with the core module or shortly after with supplementary modules conducted only once using data from the core module as frame.

8.9 The *integrated census and survey modality* comprises also a census core module to be carried out on a complete enumeration basis like the modular census. However for this modality, rotating thematic modules will follow the core module and will be conducted annually or periodically on sample basis over a longer period than in the modular approach (10 year period separating two census core modules) and may be implemented several times during this period

8.10 The latter two approaches and ways for conducting a census of agriculture aim at helping those countries where the agricultural census and survey programme is not well-developed to produce in a cost-effective way a wide range of data on various dimensions of agricultural holdings and at the same time to decrease the burden of conducting censuses. The integrated census and survey modality is proposed in order to advocate for a system that ensures a continuous flow of data instead of concentrating all resources on a single census operation. The countries with weaker statistical systems may find these modalities as an important step towards the creation of a system of integrated agricultural censuses and surveys.

8.11 The use of registers as a source of census data is also introduced as a possible modality for census taking where this is feasible. This refers to the use of registers and other administrative records as the main source of census data or in combination with some field data collection as in the three other modalities.

Table 8.1 Characteristics of census approaches and modalities

Characteristics	Census approaches and modalities			
	Classical approach	Modular approach	Integrated census and survey modality	Use of registers as a source of census data
Data collection (enumeration) phases	One-off field operation ⁴⁵	Multiple phases: a) core module b) supplementary module(s) implemented simultaneously or shortly after core module	Multiple phases: a) core module (same as modular approach or lighter) b) rotating thematic modules implemented over the period separating two census core (usually 10 years) with repetition of modules during this period	One or more field operations and use of administrative sources ⁴⁶
Coverage of census items	All census items are collected during one-off operation	Core module includes the items required at the lowest geographic or administrative levels, and/or to establish sampling frames for the supplementary module (s)	Census core module includes the items required at the lowest geographic or administrative levels, and/or to establish sampling frames for rotating thematic module (s)	Census items are collected through the field operation and use of administrative sources.
Use of complete or/and sample enumeration	Complete enumeration exclusively or in combination with sample enumeration	Complete enumeration for the core module and sampling for supplementary modules(s)	Complete enumeration for the core module and sampling for rotating thematic modules	Complete enumeration exclusively or in combination with sample enumeration ⁴⁷
Sampling frames	Built prior to the field enumeration, based on statistical and administrative data sources ⁴⁸ . A preliminary frame may be enough.	Data from the core module are used as frame for the supplementary module (s)	Data from the core module are used as frame for the rotating thematic modules ⁴⁹	For the administrative component, the frame will be from administrative source. If a sample enumeration is required, to complement the administrative source, a frame will be needed for this

8.12 When implementing a specific census approach or modality, countries should carefully consider particular national circumstances and user's expectations. However, as indicated above, in practice national conditions are so diverse, that in some cases even different elements from different census approaches or modalities may be applied by countries when implementing the agricultural census. Regardless of the census approach or modality and way of conducting a census,

⁴⁵ In a classical census all census data are collected in a one-off data collection operation during a specified enumeration period. However, certain regions of a country may be enumerated at different times of the year because of seasonal and agricultural conditions(see also paragraph 30).

⁴⁶ It will depend on the way of conducting the census enumeration (field data collection).

⁴⁷ For the items collected through census questionnaire/ filed data collection component.

⁴⁸ When sample enumeration is applied.

⁴⁹Data from other statistical and administrative sources could be used as frame for the core module

the crucial principle of providing reliable, comparable and detailed statistics at the low administrative and geographical levels, in line with user's requirements, remains of paramount importance.

8.13 Therefore countries are encouraged to develop and implement their census of agriculture tailored to their unique situation, and to be mindful of the need to collect a minimum set of data for international comparison purposes and to meet the informational requirements of national stakeholders

8.14 Before discussing each modality, an overview of some issues and recommendations common to all approaches and modalities are presented below. More details on some of the points will be provided in Part 3.

Data content of the census

8.15 The recommended data items to be covered in a census are the same regardless of the census modality. Volume 1 of WCA 2020 classifies the items to be included into the census in three categories: (i) essential items (23 items in total); (ii) frame items (15, of which 6 are also essential items) and (iii) additional items (96). The minimum requirement for a census, is that it includes all essential items, in order to enable international comparison and frame items for census modules or follow up surveys. If community-level data items are relevant to the country, the recommended items shown in Table 2.2, could also be considered for a community survey to complement the census items collected from the holdings and the other available data sources (i.e. statistical and administrative data).

8.16 The table below provides a list of recommended essential items and frame items that should be used in the process of defining the content of the census in a country.

Table 8.2 The list of essential and frame items recommended in WCA 2020⁵⁰

	#	Items	Essential item	Frame item
1	0101	Identification and location of agricultural holding	E	F
2	0103	Legal status of agricultural holder (type of holder)	E	
3	0104	Sex of agricultural holder	E	
4	0105	Age of agricultural holder	E	
5	0107	Main purpose of production of the holding	E	F
6	0108	Other economic activities of the household	E	F
7	0201	Total area of holding	E	F
8	0202	Area of holding according to land use types	E	
9	0203	Area of holding according to land tenure types	E	
10	0301	Use of irrigation on the holding		F
11	0302	Area of land actually irrigated: fully controlled and partially controlled irrigation	E	
12	0401	Types of temporary crops on the holding		F
13	0402	Area of temporary crops harvested (for each temporary crop type)	E	
14	0405	Types of permanent crops on the holding and whether in compact plantations		F
15	0406	Area of productive and non-productive permanent crops in compact plantations (for each permanent	E	

⁵⁰ FAO (2015). World Programme for the Census of Agriculture 2020. Volume 1: Programme, Concepts and Definitions. SDS 15, paragraphs 7.9 - 7.12

		crop type)		
16	0407	Number of permanent crop trees in scattered plantings (for each tree crop)	E	
17	0411	Use of each type of fertilizer	E	
18	0413	Presence of nurseries		F
19	0415	Presence of cropped land under protective cover		F
20	0501	Type of livestock system	E	
21	0502	Number of animals	E	F
22	0503	Number of female breeding animals	E	
23	0601	Use of agricultural pesticides	E	
24	0602	Use of genetically modified crops		F
25	0801	Household size by sex and age groups	E	
26	0901	Whether working on the holding is the main activity	E	
27	0902	Working time on the holding	E	
28	0903	Number and working time of employees on the holding by sex	E	
29	1201	Presence of aquaculture on the holding	E	F
30	1301	Presence of woodland on the holding		F
31	1304	Whether agro-forestry is practiced		F
32	1401	Engagement of household members in fishing activity		F

8.17 In practice the above list of 32 essential and frame items should be used as starting point in defining the scope and coverage of the census in a specific country. If community level data items are relevant to the country, the 34 recommended community level items (see WCA 2020 volume 1 para 7.16) could also be considered for a community survey to complement the census items collected from the holdings. The final list of a country specific census items should be established in consultation with all stakeholders by eliminating from the recommended lists, items which are not existent, not significant or not relevant for the country (for example if aquaculture is not important item 1201 can be eliminated) and by adding data items important for the country but not in the above list. In deciding on their specific data items, countries may consider the list of 96 additional items identified in WCA 2020 Volume 1 or select items outside that list as required. When community-level data are to be collected, the items to be included in the census questionnaire for holdings and those in the questionnaire for community survey should be clearly identified. This final list will define the total content of the census in terms of data items to be collected. It is a good practice to organise a user producer workshop to decide on the final content of the census.

8.18 In countries with well-developed registers, the use of administrative sources to cover census data items should be considered. When there is a possibility to produce reliable census-like results based on administrative data sources, the relevant items could be excluded from the census questionnaire(s).

Census frame

8.19 The frame for the agricultural census must be carefully established to ensure that all agricultural holdings are covered with no omissions or duplications during census taking and in the surveys that follow.

8.20 Where an exhaustive list of agricultural holdings is not available from a statistical farm register (land records, subsidy registers, etc. or a combination of these), a recent population and housing census or from other data sources, it is necessary to build a frame as a preparatory activity of the agricultural census. This could be done through a cartography and/or listing operation. A preliminary agricultural census frame could be developed as the list of enumeration areas (EAs) covering the entire country, which are canvassed by enumerators to screen target population of

agricultural holdings (for more details see Chapters 12 and 17).

8.21 When Population and Housing Censuses (PHC) include an agricultural section with relevant questions as is the case in a growing number of developing countries, this information can be used for developing a frame for holdings in the household sector for the agricultural census. Provided that the time span between the two censuses is not too long and depending on the content of the agricultural section of the PHC, substantial savings can be obtained on frame building and in some cases coverage of main census items. This is particularly relevant when the modular approach or integrated census survey modality are applied as discussed below. In all approaches and modalities, the frame for the non-household sector will need to be compiled separately as explained in paragraphs xx-xx.

Use of sample enumeration

8.22 As noted in the WCA 2020 Volume 1, when deciding whether to use sample enumeration in a census, in addition to efficiency considerations (precision versus costs), other elements should be taken into account, such as:

- a) desired level of aggregation for census data;
- b) use of the census as a frame for ongoing sample surveys;
- c) data content of the census; and
- d) capacity to deal with sampling methods and subsequent statistical analysis based on samples⁵¹.

8.23 As indicated in paragraph 21 above, when a PHC is conducted with detailed agricultural section (or module), the need for complete enumeration must be balanced against additional cost and the level of aggregation required for the remaining data items. In some cases, when PHC data covers both frame requirements and most of the essential data items, a sample enumeration may be enough for responding cost-effectively to country needs. In many small island countries and several countries in Africa this approach has been implemented to reduce census cost, but the non-household sector still needs to be enumerated separately.

8.24 When sample enumeration is planned to be applied the issue of building sampling frames should be carefully considered. The advantages and disadvantages of complete and sample enumeration as well as the factors to consider are discussed in details in Chapter 13 (see paragraphs 13.67- 13.80).

Thresholds

8.25 In many countries, a minimum size limit is adopted for holdings included in the census. The rationale for this minimum size limit is that generally there is a large number of very small holdings which make a marginal contribution to total agricultural production but whose inclusion in the census greatly increases the workload and census budget. Thresholds commonly used include land area, number of trees, number of livestock, value of sales or some combination of these. However, care should be taken not to have an over complex threshold.

8.26 Although this argument is acceptable for some countries, it cannot be defended in many developing countries where very small farms may together contribute substantially to total agricultural production. Small holdings are often a significant part of the agricultural structure and without information on such holdings a complete picture cannot be provided. Therefore a number of countries, especially those with an important contribution of the household sector to agricultural output and/or a less developed statistical system, do not apply any minimum size limits or adopt a very low threshold for defining eligible agricultural holdings. Countries that exclude small holdings

⁵¹ FAO, 2015, paragraph 4.34.

from complete enumeration are strongly urged to set the minimum size limit as low as possible and to consider the collection of data through dedicated sample surveys for the holdings which are below the threshold. For more details see WCA 2020, Volume 1 (paragraphs 6.30-6.31).

Data collection from holdings in the household sector and holdings in the non-household sector

8.27 In many countries agricultural holdings are divided in different types of units, which are enumerated using specific methods. For example, different frames and enumeration methods could be applied for:

- ◆ “Special” agricultural holdings (called also “commercial”, “large” farms, specialised farms such as pig farms, etc.), which usually belong to the non-household sector and provide statistical returns on a regular basis (see also Chapter 13, paragraph 13.17). Often these holdings are covered in the census using self-enumeration (such as Mail-out/Mail-back_or CASI). However, face-to-face interview could also be used to ensure the collection of the information.
- ◆ Household-based holdings, which in developing countries are commonly enumerated using face-to-face interview (see also Chapter 18).

8.28 The list of special holdings (frame) should be established prior to field data collection using relevant statistical and administrative sources (statistical farm registers, tax records, agricultural associations, chambers of agriculture, etc.). In many developing countries, the number of such holdings is usually small as compared to the number of holdings in the household sector and they are commonly covered by complete enumeration during the census of agriculture under all modalities of implementation. These holdings in the non-household sector need to be defined precisely using country specific criteria (example: farms above 10 ha, farms with more than 100 cattle, farms with an accounting system etc.).

Community survey

8.29 Regardless of the census approach or modality, decision should be made to undertake a community survey according to country needs, taking into account the 34 community items recommended in WCA2020 Vol 1. When such a survey is carried out during the census enumeration period, the community survey questionnaire could be completed via interview by census personnel. Alternatively, the community survey could be conducted at a more appropriate time but not too far from the census enumeration period in order to ensure that the same reference period is kept. Community survey may also be carried out using self-interviewing methods (such as Mail-out/Mail-back or CASI), enabling savings in the census budget. Community questionnaires should be sent to respondents well in advance to allow quality and timely provision of data. The data collection from communities is usually assisted by dedicated staff of the census agency.

8.30 The timing and modality of implementation of the community survey will depend on the overall census approach and modality selected and will be further discussed under relevant approaches and modalities.

8.31 The description of census modalities is presented in the Chapters 9 to 11.

CHAPTER 9: CLASSICAL CENSUS

Description

9.1 The WCA 2020, Volume 1 specifies that “the classical approach may be considered a census conducted as a single one-off operation in which all the census information is recorded”⁵². When carrying out a classical census, either a single questionnaire is administered to all agricultural holdings, or a combination of short and long questionnaires is used. In the latter case, the short questionnaire contains only questions intended for all holdings, while the long one is used to collect more detailed information from a specific population of agricultural holdings, e.g. above an established threshold. A classical census can be conducted by complete enumeration, sample enumeration, or by a combination of both.

9.2 Historically, the classical modality of conducting a census has been the most largely used by countries and still is widely applied. As stated in the WCA 2020, Volume 1⁵³, this approach is appropriate for countries having an integrated census and survey programme or wishing to collect census items at the lowest administrative/geographical levels.

9.3 The main distinguishable feature of a classical census conducted in the framework of WCA 2020 is that enumeration is conducted as a single one-off operation, during a specified enumeration period, providing a snapshot of the entire population at that period. It is different from the modular census approach and integrated census and survey modality, where census data are collected in multiple phases. It also differs from the use of registers as a source of census data modality, where administrative data are used not only as a frame or to support field operations, but also as the source for census information.

9.4 As mentioned, in this approach all census items are usually collected in one data collection phase. However, certain regions of a country may be enumerated at different times of the year because of seasonal and agricultural conditions (WCA 2020, Volume 1 (paragraph 6.34)). On the other hand, by extension, the classical approach also includes cases where (under the short-long questionnaire concept) the long questionnaire is completed at a second visit (see paragraph 61).

Ways and steps for implementation of the classical census

Steps and timing

9.5 Experience shows that there is a large variety of country situations which need to be carefully considered in deciding on the most appropriate way of implementing the classical census. The first step is to decide i) if complete enumeration will be used in exclusivity or in combination with sample enumeration and ii) whether a single questionnaire will be administered to all agricultural holdings, or different questionnaires, e.g. a short-long questionnaire concept will be applied. The methods of enumeration (which could be the same or specific for different types of holdings) should also be carefully considered (see paragraph 8.27). The next steps are those described at the end of Chapter 1 and in relevant chapters of Part 3.

9.6 The timing of field data collection should take into account the agricultural seasons in the country and whether one single questionnaire will be administered in one visit or if a second

⁵² FAO, 2015, paragraph 4.4.

⁵³ FAO, 2015, paragraph 4.5.

visit will be needed. In the case of one single visit, all data collection activities should be grouped in that period: household based holdings, non-household based holdings and community survey. In case of two visits, non-household sector and community surveys should be as much as possible conducted during the first visit. As indicated in Chapter 9, a key consideration is to conduct the non-household sector census and community survey not too far from the main census enumeration period in order to ensure that the same reference period is kept.

9.7 The ways of implementing a classical census according to the types of enumeration and questionnaires used are discussed below.

Types of enumeration: complete enumeration versus sample enumeration

9.8 The word “census” implies a complete enumeration of all agricultural holdings. However, by extension, it can be conducted using sample enumeration provided the sample is large enough to generate reliable sub-national data. The factors to be considered when the use of sample enumeration is foreseen are discussed in detail in Chapter 13 (see paragraphs 13.67 - 13.80). Three types of enumeration may be applied:

- ◆ Complete enumeration, where all agricultural holdings are covered in the census;
- ◆ Combination of complete and sample enumeration, where a part of the target population or/and of the census items are covered using complete enumeration and another on sample basis;
- ◆ Sample enumeration, where a large sample is drawn to survey the target population.

Complete enumeration

9.9 The census of agriculture carried out by a complete enumeration, is the traditional way to conduct a census in many countries. It is the most comprehensive way of census taking, where the result for each characteristic is obtained from the values of the characteristics in all holdings enumerated.

9.10 Commonly, in order to conduct an agricultural census by complete enumeration the total area of the country is unambiguously divided into non-overlapping identifiable areas, such as enumeration areas (EAs), which are assigned to census enumerators. When field operation is conducted, enumerators visit and administer questionnaires to all holdings in the assigned EA ensuring complete coverage and simultaneity of data collection. If the exhaustive list of agricultural holdings is not available before the census enumeration phase, enumerators canvas EAs in order to identify all agricultural holdings and administer census questionnaires.

9.11 During data collection, when the face-to-face method is used, the enumerator completes a questionnaire for each holding belonging to the target population by interviewing the respondent. In addition, in some cases the enumerator measures the fields and gathers whatever other data are needed to complete the census questionnaire. Self-enumeration procedures (such as drop-off/mail-back or pick-up) can also be applied to collect census data from holdings. For more details regarding data collection methods, including other remote data collection the reader is referred to Chapter 18. Specific features for the enumeration of special (commercial or large) holdings, which usually belong to the non-household sector, are discussed in paragraph 8.27.

9.12 This way of implementing the census is the most costly in terms of field work and challenging in terms of planning and organization. It requires mobilizing and training a large number of field staff to handle census questionnaires. Although it requires a reliable census frame like any other census modality, it is much less demanding in respect of the characteristics

contained in the frame than a sample - based census and is often the most practical way to conduct a census and build up a statistical farm register to prepare an effective sampling frame for subsequent regular agricultural surveys.

Country examples (Australia, Chile, China, Mexico, Poland) –[Link](#)

Combination of complete and sample enumeration

9.13 The census taking may involve the combination of complete enumeration with sample enumeration, where a part of the target population is enumerated on exhaustive basis and the rest using sample.

9.14 There are different ways of combining complete and sample enumeration in a classical census, such as:

- ◆ Use of complete enumeration in the most important agricultural regions of the country and/or with easy access and a sample of villages or EAs for the rest of the country (where agriculture is less important);
 - ◆ Use of complete enumeration for some types of holdings or for those above an established threshold (e.g. large holdings, which may account for a significant part of agricultural production, or in small numbers) and apply sample enumeration for the remaining holdings;
- When using complete and sample enumeration one single or different questionnaires could be applied for different sub-populations of holdings; one example of the latter case is the short-long questionnaire concept (see paragraphs [9.29-9.36](#)).

9.15 When the first category of combination (i) is applied, the target population is divided according to the location of holdings, e.g.: holdings in regions of intense agricultural production and those in other regions, and/or holdings in areas of easy access and holdings in remote areas. This approach may be especially applicable in countries where some parts of the country with difficult access contribute only a small proportion to agriculture and sample enumeration can give a good picture of the situation there in a cost-efficient way.

9.16 In the second category (ii), other criteria, such as types of holdings and/or a threshold, are applied to define the use of complete and sample enumeration. Depending on the target population of holdings this category could be further split into two sub-categories:

- ◆ The first sub-category of combination is closer to complete enumeration and refers to cases where complete enumeration is applied to agricultural holdings with the largest contribution to the agricultural production (e.g. above a certain threshold), which usually constitute the bulk of the holdings. The remaining holdings (below a certain threshold or considered small in some other sense) are enumerated on a sample basis to ensure a complete picture of agriculture.
- ◆ The second sub-category refers to cases where complete enumeration is applied for large or “special” holdings (see paragraph [8.27](#)), which may account for a significant contribution to agricultural production, while the remaining holdings, such as small and medium sized holdings (which usually constitute the bulk of agricultural holdings in countries with developing economies), are covered by sample enumeration. In fact, such a census may be considered as a sample-based census with one complete enumeration stratum and is described below.

9.17 In a classical census the agricultural holdings to be enumerated based on sampling is drawn from the frame, during the census preparatory phase, by using an appropriate sample design. Frame and sample designs issues for censuses that uses sample enumeration are discussed in details in Chapters 12 and 13.

9.18 Countries may wish to select other ways of combining complete and sample enumeration in a classical census, using different elements from the cases discussed above. For

example, complete enumeration can be applied to cover all holdings in the rural area and holdings in the urban area above a threshold, and sample enumeration for the rest of holdings (combining the first and second categories presented above).

9.19 Combining sample and complete enumeration aims at increasing cost-efficiency. However, an important disadvantage in comparison with the complete enumeration is that the sampled areas or holding types will not provide detailed statistics at the smallest administrative level and no complete frame for ongoing sample surveys. The use of sample component in the census requires a reliable sampling frame and an adequate level of expertise in survey organization and sampling.

Country examples (El Salvador, Moldova, Russian Federation, Surinam)- [Link](#)

Sample enumeration

9.20 In a sample-based census under the classical approach, a large sample of holdings is selected and enumerated in one-off operation. The sample needs to be large enough to generate sub-national data.

9.21 It is not possible to give specific recommendations on the required sample size for a sample-based census. Usually, the sample should be big enough to provide data down to the third level of administration - for example, at the national, province and district levels. Other factors, such as the sample design, agricultural conditions in the country, the data content of the census, users' requirements regarding sub-national breakdowns and the administrative structure of the country are also important. Frame and sampling designs for censuses that uses sample enumeration are discussed in details in Chapters 12 and 13.

9.22 The probability for selection of agricultural holdings for sample enumeration can be drawn from the sampling frame built-up based on a recent population and housing census, a statistical farm register and/or other statistical and administrative sources. For more details regarding the frame and the sample design the reader is referred Chapters 12 and 13.

9.23 The inclusion of a set of agriculture-related items in the population and housing census can be useful for countries planning to conduct the agricultural census based on a sample enumeration. Countries may wish to include for this purpose in their population and housing censuses an agricultural module with the items needed to build-up the sampling frame for a subsequent agricultural census. The recommended frame items to be collected through the population census are discussed in WCA 2020 Vol. 1 (paragraphs 5.14-5.18). In case where the time separating the two censuses is too long, the frame information collected in the agricultural module of the population and housing census may be out of date and a field operation may be required to update the sampling frame for the implementation of sample enumeration. See also paragraph [8.21](#) above for cases where substantial agricultural census items are included in a population census.

9.24 Sample-based census under the classical approach differs from the modular approach with supplementary module(s) conducted as part of a single data collection operation. In the former, sample is designed prior to census field work, while in the latter approach the core module provides the sampling frame to carry out the supplementary module(s) (see Chapter 10).

9.25 Sample enumeration is less costly in terms of field work and reduces the respondent burden in comparison with complete enumeration. However, it requires a reliable sampling frame with adequate auxiliary information, as noted earlier, as well as a high-level expertise in survey organization and sampling, especially to develop a suitable sample design, as well as to clearly define the implementation procedures during field operations.

Types of questionnaires used

Single questionnaire

9.26 In a classical census, a single questionnaire might be administered to all agricultural holdings, without regard to their type (i.e. household and non-household sectors), size, location, etc. When appropriate, specific items or/and sections in the questionnaire, which are not relevant for certain types of holdings will not be completed. For example, in a non-household based holding, such questions as about household members (such as social-demographic characteristics, work on the holding) or kitchen gardens will be skipped. A single questionnaire is especially relevant when the census is conducted by complete enumeration. An important advantage in comparison with multiple census questionnaires is that a single questionnaire is easier to apply in the field (as the same type of questionnaire is administered to all holdings) and can be less costly with respect to printing, logistics, the development of data processing applications, etc.

Short-long questionnaire

9.27 When some topics or items need more in-depth study, a short - long questionnaire concept can be used. In this approach a short questionnaire is applied to all holdings while a long, more detailed one is used to target a specific population or a sample of holdings.

9.28 The purpose of this concept is to increase the range of census items by including items relevant to a subset of the population, using the long questionnaire in addition to, the information collected through complete enumeration. This means that for key items (such as essential and frame items) complete enumeration of all holdings is undertaken, but for various additional items only a sub-population of the holdings is enumerated. These additional items could be more difficult to collect and could involve in-depth questioning of the respondents.

9.29 The short questionnaire is administered to all agricultural holdings on a complete enumeration basis, while the long questionnaire is administered only to:

- ◆ holdings identified according to certain criteria, such as being above an established threshold or belonging to a particular segment of the population;
- ◆ a sample of agricultural holdings.

9.30 In the first case, the criteria to define the sub-population covered by the long questionnaire could be: threshold requirements (such as total area of holding, area by main land use types, livestock by major types, area equipped for irrigation, etc.) and/or types of holdings (such as holdings from the non-household sector), etc. In this approach, the short questionnaire could be administered to screen the target population, while the long questionnaire will be assigned only to holdings meeting the defined criteria.

9.31 In the second case, the long questionnaire is administered to a sample of holdings, which is drawn from the sampling frame during the census preparatory phase prior to the census enumeration. For instance, the complete enumeration may be used to apply the short questionnaire with the items where detailed information at the lowest geographic level is required and the sample enumeration could be used to administer the long questionnaire with the items where more aggregated information is acceptable and/or which are more difficult to collect (e.g. items on parcels of land or on agricultural practices). The reliability of the sample

results has to be taken into account when deciding what questions to include in the short and long questionnaires. In this case additional information is needed in the preparatory phase to carefully design the imbedded sample for administering the long questionnaire.

9.32 Under the short-long questionnaire concept, the detailed items of the long questionnaire may refer to a specific theme (e.g. land, irrigation, crops, livestock, agricultural practices, work on the holding, etc.), to several themes, or include only specialized items, such as on permanent crops (or just on vineyards, or orchards), greenhouses, nurseries, machinery and equipment, etc.

9.33 The long questionnaire may be completed at the moment of the first visit of the enumerator (together with the short form), or at his/her second visit. In the latter case, during the first visit only the short questionnaire is applied to agricultural holdings, while the long questionnaire is administered during the second visit to holdings identified as belonging to the subpopulation of interest or to a sample of such holdings.

9.34 The use of Computer Assisted Personal Interview (CAPI) (see Chapter 18) can facilitate the field work. The device can be programmed to use information collected in the short questionnaires to identify the sub-population to apply the long questionnaires.

9.35 This way of implementing the census requires mobilizing and training a large number of field staff to handle both simpler questions for the short questionnaire and detailed ones for the long questionnaire. In addition, the field staff should be well trained to apply adequately the sampling plan or the rules of selection of qualified holdings for the long questionnaire.

Country examples: Antigua & Barbuda, Bangladesh, St. Lucia - [Link](#)

Other types of questionnaires

9.36 Countries' experiences show that specific census questionnaires could be designed to fit different segments of the target population (see Chapter 18). In many countries, different questionnaires are used to collect data from household-based holdings and from non-household holdings. In that case, the census questionnaire for holdings in the household sector, apart from the common set of census items, includes items that are relevant only for this sector, such as those related to the main purpose of production of the holding, area of kitchen gardens, demographic and social characteristics, work on the holding of household members⁵⁴, etc.

Another possibility is to use specific questionnaires for different provinces when these differ considerably in cropping and livestock systems, and in agricultural practices. In this case: a) more detailed, specific information could be collected in some provinces or/and b) some items could be removed completely from the questionnaire of one province and its length reduced considerably. For example, if one province is known to be almost exclusively a livestock production area and owing to its physical characteristics has no permanent crops, the questions regarding crops may be reduced and those relating to livestock expanded. However, this should be carefully analysed as it would be assumed that the value of the census characteristics in the regions where some items are not collected at all will be zero. Also, the use of specific questionnaires for different provinces, types of holdings, etc. may involve additional costs, such as related to printing logistics, the development of data processing applications, etc.

Country examples (Brazil, Ireland, Lithuania, USA) – [Link](#)

⁵⁴ See Chapter 8 of the WCA 2020 Volume 1 for more details regarding census items recommended to be collected for holdings in the household sector

Main advantages, disadvantages and requirements of the classical census

9.37 The main advantages, disadvantages and requirements of the classical census are briefly presented below.

Advantages

9.38 As indicated before, the biggest advantages of a classical census are comprehensiveness of coverage and simultaneity. The classical census has merit in providing a snapshot of the entire target population at a specified period and comprehensive data sets available at the lowest geographical level.

9.39 Essential features of an agricultural census conducted using complete enumeration are fully satisfied with the classical census approach. The results provided by a classical census constitute a solid foundation for good sectoral planning. Data can be produced at lowest administrative and geographical levels with no sampling error. The census results allow various tabulations in line with high user's requirements, including data for small administrative units and information on rare events, such as emerging crops, rare crops and types of livestock, which may be of significant economic importance, especially for some regions or sub-populations of agricultural holdings.

9.40 Although it requires a reliable census frame, like any other census approach or modality, the classical census when conducted by complete enumeration is much less demanding in respect of the characteristics contained in the frame than the sample - based census. Along with this, classical census by complete enumeration can constitute a good basis for building up a statistical farm register and an exhaustive sampling frame for subsequent regular agricultural surveys.

Limitations

9.41 One of the biggest disadvantages of a classical census when conducted by complete enumeration is its cost and administrative complexity. Classical censuses have been singled out as the most costly census taking. Because of the important financial resources needed for a complete enumeration, countries sometimes struggle to mobilize sufficient resources in due time to conduct properly this exercise.

9.42 A classical census by complete enumeration implies a huge effort to collect detailed information on agricultural holdings, but also a higher burden on respondents than a census conducted on a sample basis. This can be an important disadvantage in countries where the participation in the enumeration is declining or resources are limited.

9.43 One possible drawback of the approach (complete enumeration) is the risk to overburden the census questionnaire because of the high pressure from some policy makers or other stakeholders to include detailed items to collect data at the national level and at the lowest administrative level. This is especially the case for countries with a weak agricultural statistics system, which are tempted to use the agricultural census to collect apart from structural data other information, which normally should be collected through regular agricultural surveys.

9.44 Another disadvantage in a complete enumeration census is the very large number of enumerators and supervisors required. Quite often candidates for field staff with desired qualifications are not available in a sufficient number so the minimum requirements has to be lowered with a possible negative impact on the quality of data collected. Along with this, adequate training of a large number of field census staff in a short period poses also a challenge.

The lack of trained and experienced field staff, including the lack of good quality field supervision, along with other difficulties related to the organisation of field data collection for a large number of holdings could lead to significant factors causing non-sampling errors in a classical census.

9.45 The amount of data to be processed is very large for a complete enumeration census, which affect both the budget and the timeliness of census results. The production and dissemination of results may be considerably delayed if not sufficient data processing capacities are in place.

9.46 As discussed earlier, in order to make the classical census more cost-efficient, some countries, instead of complete enumeration census conducted with a comprehensive questionnaire, chose the combination of complete and sample enumerations or the short-long questionnaire concept. These ways of conducting a census aim at reducing census costs and overall respondents' burden, while collecting detailed information about some segments of the target population or topics of special interest. More details about the advantages and disadvantages of complete and sample enumeration, as well as the factors to consider are provided in Chapter 13 (see paragraphs 13.67- 13.80).

Requirements

9.47 As indicated above, the classical census has many advantages, but also disadvantages as compared to other census modalities. This census approach should be considered in countries where conditions are suitable for its effective implementation. Some of the main requirements in order to minimize the disadvantages include the followings:

- ◆ Organization capacity and good planning due to the sheer volume of work and overlapping time frames.
- ◆ Since a classical census by complete enumeration requires substantial resources, sufficient and timely budget allocation during census preparation, field operation, data processing and dissemination needs to be ensured.
- ◆ Full awareness and agreement of the target population to participate in the enumeration, and trust towards the statistical office/census agency.
- ◆ Availability of sufficient number of field staff with minimum level of qualification that can be mobilized to conduct census field works.

9.48 Additionally, when conducting classical census with the use of sample enumeration, e.g. in combination with complete enumeration or under short-long questionnaire concept, there are additional requirements, such as:

- ◆ Availability of a good survey organization capacity of the census agency, including adequate sampling expertise.
- ◆ Availability of a reliable sampling frame.

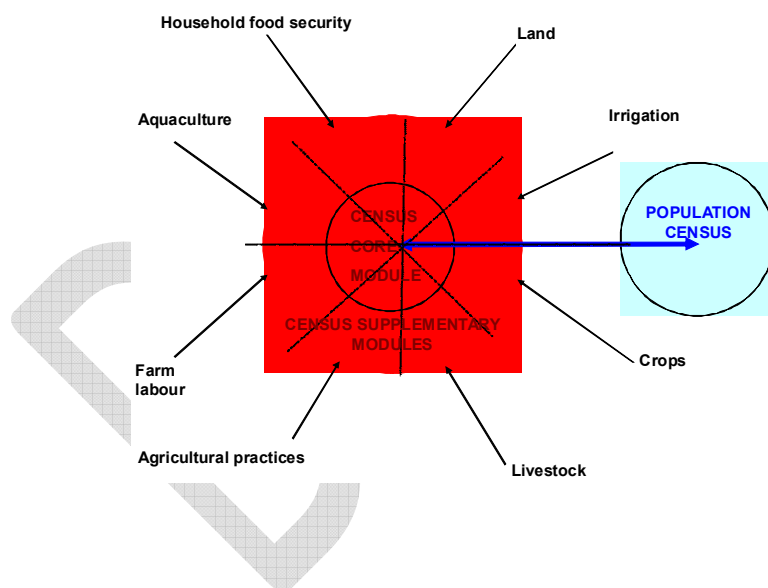
CHAPTER 10: MODULAR CENSUS APPROACH AND INTEGRATED CENSUS AND SURVEY MODALITY

MODULAR CENSUS

Description

10.1 This approach for conducting a census of agriculture was introduced in the WCA2010 programme in order to help countries meet the need for a wider range of data while minimizing the cost of census taking. WCA2020 programme maintains this approach with a clearly distinguishable core module to be conducted on a complete enumeration basis and one or more supplementary modules to be conducted on sample basis at the same time or shortly after the core module and only once. Core and supplementary modules should be conducted in a short period of time, usually 1 to 2 years one after the other.

10.2 An essential condition is that data from the core module should be used as frame for the supplementary module (s). Therefore, the census using the short-long questionnaire in one operation is not considered as modular census. The modular census retained in WCA2020 can be illustrated in the following figure (modified from WCA2010):



10.3 WCA2020 Volume 1 groups the recommended census data items in themes and there are 15 themes each of which relates to a possible topic of interest (example Land, irrigation, crops, livestock etc). In the modular census, a 'module' is defined as a group of data items to be collected on a specific target population. A supplementary module will usually include a group of data items from one specific theme when they relate to the same specific target population. For example a supplementary module on livestock will include data items from the livestock theme

to be collected from holdings with livestock. The specific target population can be all holdings if the items are relevant to all or a subset of the agricultural holdings for which data items are relevant. For example a module on work on the holding to collect detailed information on that topic may concern all holdings while a module on irrigation may concern only those holdings having irrigation. In some specific cases, items from several themes can be combined into one module (example of GHG environment, agricultural practices etc..).

10.4 When more than one supplementary module is present, data may be collected in a single survey (when the data items for the modules are relevant for the same target population) or in several separate surveys when distinct target populations are concerned. For example, data for a supplementary module on crops may be collected jointly with data on agricultural practices while a module on livestock and a module on aquaculture may concern different target populations and therefore may be collected separately through different surveys. An important consideration should be to minimize operational cost by collecting data on different modules, whenever possible and avoid visiting the same holdings several times for different modules.

10.5 During the data collection for each supplementary module, one or more questionnaires may be used to cover all data items. Questionnaires may be organized in sections grouping items from different themes, which are not to be considered as 'modules' in the sense of the modular census.

10.6 The recommended data items to be covered in the modular census approach are the same as all other census modalities and are discussed in paragraphs 8.15-8.18 above. Regarding the modular census, some flexibility is given to countries to define the content of their core and supplementary modules. However it is recommended that the core module includes frame items as well as any other items on the census list of items, or even outside this list and that between the core and the supplementary modules, **all essential items should be covered**. The table 2.2 above provides a list of recommended essential items and frame items.

10.7 The next step in the modular census will be to decide what items should be included in the core module and what items should be included in the supplementary modules and eventually what should be in Community surveys. Again the Table 8.2 with the adjusted list of data items can be used as starting point for selecting data items that should be included in the core and other modules. If other country specific items have been added to the list of recommended items, they should be either included in the core or supplementary modules or community survey if relevant. If they are not in the core module, data needed to build a suitable frame for their collection in the supplementary modules should be included in the core. Countries should make this decision depending on their national requirements, taking into account cost and resource availability, including financial and human resources.

10.8 For items to be included in the core module, the following criteria defined in WCA2010 remain still valid and should be considered:

- ◆ The items are the key items needed for agricultural policy-making and planning.
- ◆ Data for the items are required to be produced for small administrative units such as districts or villages, or in the form of detailed cross-tabulations. Such data could not be provided from supplementary modules conducted on sample basis because of high sampling errors. For example, if livestock numbers by age and sex are needed at the district or village level, these items may need to be included in the core module, rather than a supplementary module.
- ◆ The data involve the measurement of rare events, such as unusual crops or livestock, which would not be possible to estimate from supplementary modules conducted on sample basis because of high sampling errors.

- ◆ The data are required to establish sampling frames particularly for supplementary modules and other surveys. Where possible, countries should plan their supplementary modules and other agricultural survey programme at the same time to ensure that the core module can be designed to meet the sampling frame needs. For example, if an in-depth aquaculture supplementary module was to be conducted, item 1201 on the presence of aquaculture on the holding should be included in the core census module for sampling frame purposes. If the frame to be established uses cut-off limits, the identification of these thresholds also needs to be built into the core module.
- ◆ The data are required to make international comparisons when not included in the supplementary modules.

10.9 Regarding the supplementary modules, they use the frame generated by the core module to target specific populations, which can be all agricultural holdings, holdings above a certain size or subsets of agricultural holdings, such as livestock producers or crop producers – again, with or without size considerations as indicated in WCA2020 Volume 1 paragraphs 6.30 – 6.32. For example, a livestock module may target all holdings with livestock or holdings above a threshold defined in terms of number or type of animals.

10.10 Countries should carry out one or more census supplementary modules according to the national requirements, based on the list of agreed census items. Supplementary modules should be used to collect more detailed data on a limited number of topics relevant to the country. They should cover the rest of the agreed census items that are not included in the core module. Modules can be thematic in nature where the target population is a subset of holdings, or include multiple themes where the target population is the same for a group of themes as explained in paragraphs 10.46- 10.47.

10.11 This combination of core and supplementary items allows the modular census to produce a more extensive and country specific range of data compared with the classical census modality. In addition, some countries may consider conducting Community level surveys to provide additional data on specific agricultural features of rural communities.

Link to an example of content of Core and supplementary modules in selected countries (Togo and Cambodia?)

Ways and steps for the implementation of the modular census

Steps and timing

10.12 Once the content of the core module and supplementary modules are defined, the next step is to decide on the way and timing of implementation of each one of these components. The timing of data collection on the non-household sector and on community level surveys should be synchronized as much as possible with the core module.

10.13 The timing will depend on the availability of dedicated staff for doing the data collection. Efforts should be made to cover the special holdings as closely as possible to the implementation of the core module in the household sector to ensure that the same reference period is used for all items collected. In some countries, the data collection for holdings in the non-household sector is conducted towards the end of the implementation of the core module. By this time, there is less work pressure on staff and some experience has been gained that can be used for more efficiently conducting this data collection.

10.14 The community survey can also be conducted during the first phase (core module) depending on resource availability. In effect, since complete enumeration will be done during this phase, all communities will be visited and community data may be collected. However, it should be noted that this will increase the time and cost of the field work. Alternatively, a dedicated community level survey could be conducted at a more appropriate time but not too far from the census period in order to ensure that the same reference period is kept for all census items.

10.15 In introducing the modular census, WCA2010 discussed 2 ways of implementation: (i) implementing core and supplementary modules separately or (ii) implementing the core module and the supplementary module(s) as part of a single data collection operation.

10.16 However, experience shows that there are a variety of country situations that need to be considered in deciding on the ways of implementing the modular census. Depending on sources of data for building the frame for supplementary modules, the country situation may be similar to one of the following scenarios:

Core module with complete enumeration as source of frame for the supplementary module (s)

10.17 In this scenario, the country may select one of the two ways of implementation proposed above and the steps to follow are discussed below for each case.

Implementing core and supplementary modules separately

10.18 The core and supplementary module(s) can be done in separate rounds of data collection. This way of implementing the core and supplementary modules is by far the most frequently used by most countries. In this case, the census is conducted in two phases:

- a) In phase 1, the core module is first implemented and data is collected on items included in that module. The questionnaires are returned to the office for processing and building frame (s) for the supplementary module(s) and using the information to select the sample(s) for the supplementary module(s) according to the design decided.
- b) In phase 2 to be conducted shortly after phase 1, Enumerators return to the field to carry out the census supplementary module(s) on the selected sample (s) of holdings for the module(s). It is important that the supplementary module(s) are carried out as closely as possible to the core module so that the frame can be readily used and the same reference period can be kept for all census items. However, in cases where the supplementary modules are carried out over a long period of time, some updating of the census frame may be necessary, in advance of the field work.

10.19 Compared to the single data collection operation, this two phases approach is likely to cost more since it involves returning to the field. But, it allows more time for better planning the surveys for supplementary modules and part of the personnel used for core module may be used with a potential positive impact on data quality since they will be more experienced and training will be more focused.

Country examples (Cambodia, Togo, Bangladesh)- Links

Implementing the core module and the supplementary module(s) as part of a single data collection operation.

10.20 This way of implementation is not frequently used by countries. WCA 2010 provided some guidance on this way of implementation of the modular census using a single questionnaire or separate questionnaires for each module. This requires the following steps in terms of organization of the field work:

- ◆ Collect data for the core census module.
- ◆ Apply specific sampling procedures, based on responses to the core module questions, to determine whether the holding is included in the supplementary module(s). A separate sampling scheme (with different sampling design and different sample sizes) can be used for each module. For example, with supplementary modules on aquaculture and livestock, the sampling procedures might require that, in certain pre-assigned sample EAs, each holding with aquaculture is included in the aquaculture module and each holding with livestock is included in the livestock module.
- ◆ If the holding is included in the sample for the supplementary module(s), proceed to ask the additional questions required for the supplementary module(s). Otherwise, the interview is finished.

10.21 This way of implementing the modular census in one single data collection operation may seem less costly in terms of field work but can be challenging in terms of survey planning and sampling design. Designs for each module should be defined in advance and rules of sample selection based on information from the core module should be specified also in advance.

10.22 This requires high level expertise in survey organization and sampling to develop a suitable sampling design for each supplementary module and define clear rules of implementation during field work. It requires mobilizing and training a large number of field staff to handle not only simple questions for core module, but also more detailed questions for supplementary modules. In addition, the field staff should be well trained to apply adequately the rules of selection of qualified holdings for specific module according to sampling design.

Country examples - Links

Agricultural data from a recent population census as source of frame data for supplementary modules

10.23 As recommended by FAO a growing number of countries are linking the population census with the agricultural census by including an agricultural section in their population and housing censuses. The content of these sections in terms of frame items for supplementary modules of modular censuses vary from one country to another. In some countries only a limited number of items (2-3 items) can be included in the population census while in others a large proportion of recommended frame items may be collected in agricultural sections of population censuses. Therefore, countries may consider the following ways of implementation of modular census that suits their situation:

- a) Only few items are included in the population census, not enough to provide all frame items needed for supplementary modules. In this case, scenario A applies with a lighter core module to collect missing frame items and any other item suitable for the core. For example the two basic data items recommended in WCA2020 volume 1 will only provide the list of agricultural holdings in the household sector.
- b) Most of the frame items needed to implement supplementary modules have been collected in the agricultural section of the population census. In this case, the country may use

this information to implement the supplementary modules as indicated in A (i). However, in case where the time separating the population census from the agricultural census is too long, some of the frame information may be out of date and an updating operation may be required prior to conducting the field work for supplementary modules. For more information on frame maintenance and updating, see *Handbook on Master Sampling Frame for Agriculture year xxx*.

Country examples (Mozambique)- Link

Administrative sources to provide data on items in the core module including frame data for supplementary modules

10.24 Chapter 11 on the use of registers as a source of census data provides more detailed discussion on the use of administrative data in conjunction with other modalities to conduct the census at reduced cost.

10.25 In countries where administrative data system are well organised and of good quality data may be available to provide a large proportion of all essential data items, including data for building frames for supplementary modules. This information can be therefore used to implement one or more supplementary modules to collect the rest of the essential data or specific data of interest to the country.

Example of IACS in EU countries- Link

Main advantages, limitations and requirements of the modular census approach

Advantages

Cost-effectiveness:

10.26 The modular census allows focusing resources and efforts on a limited number of data items to be collected through complete enumeration (core module). In case phased approach is used, once the complete enumeration exercise is finished and results are available, the supplementary modules can be implemented to collect data for which small area estimates are not so important.

10.27 This approach is cost-effective and it forces a good planning of which variables are specially needed for small areas (villages, districts, municipalities, etc) and which parameters can be estimated at higher geographical or administrative level (country, state or regional).

10.28 In countries where most items for the core module are taken into account in the population census, and there is close collaboration between the National Institute of Statistics and the Ministry of Agriculture advantages may include: (i) Cost Reduction by sharing logistics and survey equipment frame information readily available for supplementary modules; (ii) Use the same identification for households, concepts and definitions, and cartographic works which should facilitate data integration and analysis.

More detailed information available on topics of interest and broadening the scope of the census:

10.29 Another advantage is that the modular census allows collecting more detailed information on topics included in the supplementary modules. The level of details that can be included in the modules go far beyond what can be included in the classical census conducted by complete enumeration. For example, gender or environment data at household level which are variables that are not usually collected in-depth in an agricultural census, can be included in a specific supplementary module.

Better training of field staff

10.30 When phased approach is used, the modular census also allows a better and more detailed training of field personnel. For the core module, since there are only fewer data items than in the classical census training sessions can be more focused. For the supplementary modules, when taken after the core module, the number of field personnel is much lower and these personnel can be selected among the ones with the best performance during the complete enumeration work. These enumerators will already basic training and can receive more in depth training on specific themes.

First step towards the establishment of a system of integrated censuses and surveys

10.31 Countries with a not well established system of agricultural surveys and limited budget may find the modular approach as a logical first step towards the creation of a system of integrated agricultural censuses and surveys.

Limitations

10.32 One drawback of the approach is the risk of having a core module with too many items in response to high pressure from some policy makers or other stakeholders to have detailed data for geographical or administrative entities. The resulting high cost will reduce the relative benefits of the modular approach as compared to classical census by complete enumeration. Therefore, a good balance must be kept between the core module and supplementary modules, in terms of data items and budget allocation.

10.33 The lack of well trained professional staff in statistics and sampling can be a major constraint for effectively implementing the modular census which is more demanding for such staff.

10.34 Sometimes, for logistic reasons, a country would prefer to take supplementary modules at the same time as the core module. This can be very difficult and if not properly organized, can lead to lower quality data.

10.35 This modality has some limitations in terms of cross tabulation between variables in the core and variables in the supplementary modules or between variables in different supplementary modules not conducted jointly. In theory one could think of record linkage between holdings in the core and holdings in one or more supplementary modules if same identifier is used and if time lag is not too long. However, several country experiences regarding record linkage has shown that it is a very challenging task and not all countries (particularly developing countries) can overcome the challenges.

10.36 If the time lag between the implementation of the core module and the supplementary modules is too long, the benefit of having a good frame from the core module disappears and an updating operation should be conducted which adds to the cost.

10.37 Another limitation in countries where core module is largely covered in a population census has to do with mobilization of funding. If census managers present the population census as a population and agricultural census because it contains an agricultural module, it may be very difficult afterwards to mobilize funds for supplementary modules. Therefore care should be taken in communicating properly when the two censuses are linked. Also, access to the population census files related to agricultural module has proven to be not straight forward in some countries.

10.38 Past experience shows that some countries have a long duration (3-4 years) of implementation of the modular census (basic module, modern sector, community survey,

supplementary modules). In such cases the total census cost may require a higher budget which can be challenging: (i) for the mobilization of funding; (ii) possible confusion between the core of the agricultural census (Basic module, and eventually the Community survey) and supplementary modules with different reference period; (iii) may involve extra work in preparing the agricultural census.

10.39 In the absence of a rigorous programming, in practice the extra work occasioned with the conduct of the census and publication of the results of the first phase of the census (basic module, modern sector and community surveys) does not leave the time needed for better preparation of supplementary modules.

Requirements

10.40 This census modality should be considered in countries where conditions are suitable for its effective implementation. Some of the main requirements in order to minimize the disadvantages include the followings:

- ◆ Good planning and survey organization capacity, including minimum sampling expertise.
- ◆ Possibility of building a good frame
- ◆ Adequate budget allocation between core and supplementary modules
- ◆ Capacity and resources to conduct core module and supplementary modules with a short time lag
- ◆ Availability of field staff with minimum level of qualification that can be mobilized to conduct sometimes complex surveys for supplementary modules
- ◆ A good cooperation and coordination of census activities between interested institutions, especially when different authorities are involved in census implementation (if, for instance, core module is implemented by National Statistical Office, but livestock module – by the Ministry of Agriculture/Livestock);
- ◆ good partnership in the organization of a comprehensive census publicity communication/public awareness campaign.

INTEGRATED CENSUS/SURVEY MODALITY

Description

10.40 In WCA 2020 Vol 1, it is recognized that ‘including too many items in a single statistical enquiry would be counterproductive and so the concept of the modular approach was introduced. It was also recognized that many of the items in the supplementary modules could not be considered “structural”, in the sense of not changing rapidly over time, and it could be argued that they were better suited to the statistical survey programme.

10.41 The integrated census/survey modality for conducting a census of agriculture was introduced in the WCA2020 programme in order to help countries with weaker statistical systems to produce in a cost-effective way a wide range and a regular flow of data on various dimensions of agricultural holdings and at the same time to decrease the burden of concentrating all census data collection activities in a short period of time as foreseen in classical census (one year) and modular census (2-3 years).

10.42 The integrated census/survey modality aims at rolling out the collection of thematic data (after the core module) over longer period separating two censuses with core module by complete enumeration (usually ten years).⁵⁵ Compared to the modular census, its distinguishing features are a number of rotating thematic modules⁵⁶ to be conducted annually

⁵⁵ The 10 years interval is indicative since in some countries, the frequency of the Census may be less than 10 years

⁵⁶ Equivalent to the supplementary modules of the modular census

or periodically on sample basis over a 10 year period through an annual survey infrastructure such as the FAO Agricultural Integrated Survey programme (AGRIS)⁵⁷ generating structural and current data. The other distinction with the modular census is that the rotating modules can be conducted several times during the ten year period, separating two Census core, ensuring a more frequent update of data. The principle of covering census data through core module and supplementary modules (rotating thematic modules in this modality) is the same as in the modular census, but the time span for implementing the supplementary modules and their frequency is different.

10.43 In most countries with advanced statistical systems, an adequate survey system is usually in place so that the census is an element of an integrated census and survey programme which generates a regular flow of data on agriculture during the census year and in all years separating two censuses. In countries where the agricultural statistics system is not well developed, the census of agriculture is usually an isolated one off operation mobilising a large amount of resources in a short period of time followed by several years of data discontinuity⁵⁸. The Integrated Census/survey modality aims at helping those countries to take the opportunity of the census and the large amount of resources mobilised to roll out data collection through a core module and rotating thematic modules implemented over a 10 year period separating two successive census year⁵⁹. The integrated census and survey modality is proposed in order to advocate and provide tools for a system that ensures a continuous flow of data instead of concentrating all resources on a single census operation. The countries with weaker statistical systems may find this modality as an important step towards the creation of a permanent system of integrated agricultural censuses and surveys.

10.44 When the annual survey system for rolling out the rotating modules is based on FAO AGRIS, several technical resources will be available for use by countries. AGRIS includes a Toolkit with the necessary resources in terms of (1) methodology, (2) specialized survey tools and instruments that use the latest knowledge and technology and cover the full range of survey steps, and (3) budget and institutional framework guidelines. Therefore, the AGRIS toolkit will be the reference document for the implementation of the various rotating modules. The following paragraphs will focus more on the content and ways of implementing the integrated census/survey modality particularly when AGRIS is used.

10.45 An illustration of the implementation of this modality with AGRIS is given in the table below as an example (to be adjusted to country specific situation):

⁵⁷ The AGRIS is a modular survey program which is to be articulated with the agricultural census programme and conducted on an annual basis between two censuses. It consists of one annual core module (crop and livestock production) and four rotating modules: *'economy', 'labour force', 'machinery and equipment', and 'production methods and environment'*. Additional modules can be added as needed. In the integrated census and survey modality, AGRIS is synchronized with the agricultural census with light core module and operates over a 10-year cycle.

⁵⁸ AGRIS concept note indicates that the majority of International Development Association (IDA) countries⁵⁸ have not conducted any agricultural annual surveys or censuses over the last 15 years, when the note was first drafted in 2014.

⁵⁹ The reference census year is the year in which the core module by complete enumeration is conducted

Figure 10.1: Example of possible modules and timing of their implementation (for illustration purpose): *Recommended AGRIS modules flow*

		Years	1	2	3	4	5	6	7	8	9	10
Core Module	AH Identification		•	•	•	•	•	•	•	•	•	•
	Crop + livestock production		•	•	•	•	•	•	•	•	•	•
	Other key variables		•	•	•	•	•	•	•	•	•	•
Rot. Module 1	Economy		•		•		•		•		•	
Rot. Module 2	Labour			•				•				
Rot. Module 3	Machinery, Equipment, Assets and Decisions						•					
Rot. Module 4	Production Methods and Environment					•				•		

Source: AGRIS concept note

10.46 The recommended data items to be covered in this census modality are the same as all other modalities and the final list should be decided as explained in paragraphs 8.15 – 8.18.

10.47 The next step will be to decide among the agreed census data items, what items should be included in the core module and what items should be included in the rotating thematic modules and eventually what should be in Community surveys. If country specific items have been added to the list of recommended items, they should be covered in the census core module or if they require detailed questions to be collected on a sample basis, data needed to build a suitable frame for their collection in the rotating thematic modules should be included in the census core module.

10.48 The criteria listed in 2.2 for items to be included in the core module of modular census are also valid for the core module of this integrated census/survey modality with more emphasis on data required to establish sampling frames for rotating thematic modules.

10.49 Like the modular census, flexibility is given to countries to define the content of their core module and rotating thematic modules. Countries should make this decision depending on their national requirements, taking into account cost and resource availability, including financial and human resources. However, between the core and the rotating thematic modules, **all essential census items should be covered**. The implementation frequency of the rotating thematic modules will depend on the countries' agricultural statistics systems and data demand priorities

Ways and steps for the implementation of the integrated census

Steps and timing

10.50 The steps and timing indicated under the modular approach in paras 10.12 -10.14 applies largely to the integrated census/survey modality. The main difference will be in the timing of the implementation of the rotating thematic modules which will be implemented over a 10-year period with modules being implemented more than once.

10.51 The implementation of the integrated census/survey modality will start with a census

core module on a complete enumeration basis⁶⁰. As discussed in paragraphs 10.17-10.24 countries may consider the three ways of implementation of this modality, depending on the main source of frame data:

Census core module with complete enumeration as source of frame for the rotating thematic module (s)

10.52 The core module and the rotating thematic modules will be conducted as follow (see example in Figure 10.1, in paragraphs 10.45):

- ◆ During the first year the core module is first implemented through complete enumeration (and where possible together with AGRIS core⁶¹ on a sample). The frame data collected is processed and analyzed to build required frames for the subsequent rotating thematic modules (and AGRIS annual production module if adopted and where relevant).
- ◆ This frame information is used to design the surveys that will be implemented in the following years to collect data for the rotating thematic modules and AGRIS annual production module until the next census.
- ◆ From year 2, selected thematic modules will be implemented on as illustrated in figure 1. When using AGRIS, AGRIS annual production module will be implemented annually while each rotating thematic module will be implemented every 2 or 3 years. Therefore, each year there will be a survey covering AGRIS annual production module and one or more rotating thematic modules. The annual surveys will therefore be a combination of components of farm structure data and current production data providing a continuous flow of data and allowing more frequent update of some structural information.

Country examples from AGRIS pilot test –Link Integrated survey system in Australia

Agricultural data from a recent population census as source of frame data for rotating thematic modules and AGRIS annual production module

10.53 As for the modular census, when an agricultural section was introduced in a recent population census this information may be used to prepare frames for rotating thematic modules (and eventually AGRIS annual production module) depending on the scope of the agricultural data collected during the population census. The different cases discussed in paragraphs 10.23-10.24 apply also here.

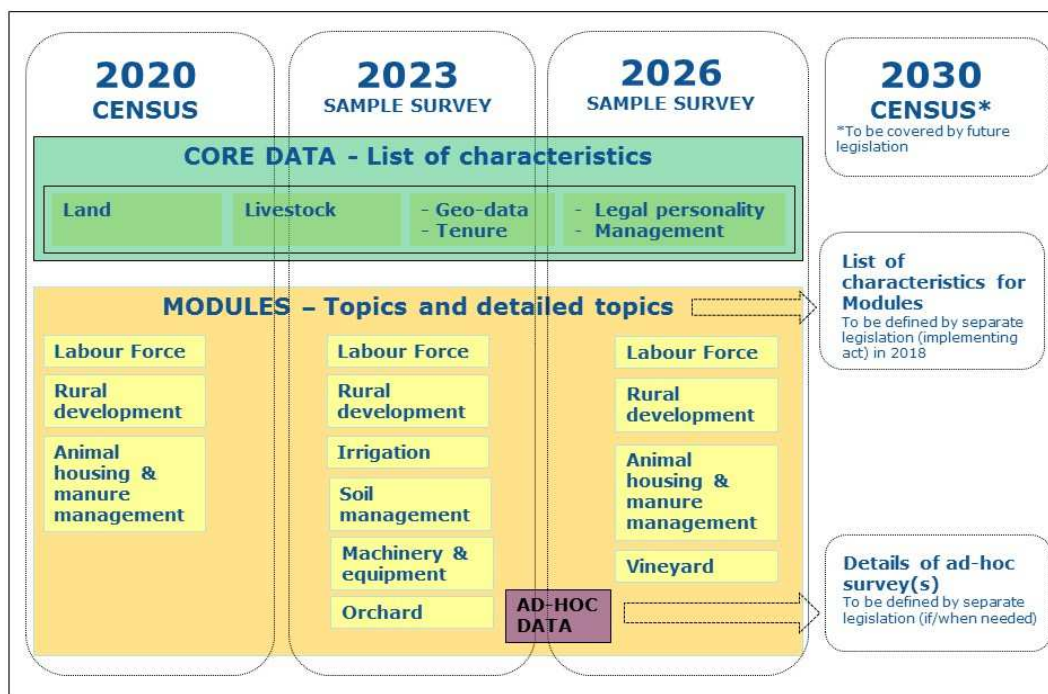
Administrative sources to provide data on census items including frame data for rotating thematic modules and AGRIS annual production module

10.54 In countries where administrative data is well organised and of good quality data may be available to provide a large proportion of all essential data items, including data for frame of rotating thematic modules. This information can be therefore used to implement the rotating thematic modules to collect the rest of the essential data or specific data of interest to the country. The different cases discussed in **paragraphs 10.24 and 10.25** apply also here.

⁶⁰ In countries where this is particularly relevant and feasible. the **core module of AGRIS** covering crop and livestock production (on a sample basis) could be also covered at the same time

⁶¹ The main items in the AGRIS core are crop and livestock production. In order to avoid confusion with the Census core, AGRIS annual production module will be used in this chapter in place of AGRIS core

Figure 10.2 New EUROSTAT farm structure survey with rotating modules



Source: ICAS PPT on EU Strategy for Census of agriculture 2020 and beyond: methodology (structural data)

Country examples (?) - Link

Main advantages, limitations and requirements of this census modality

10.55 Most of the **advantages** indicated for the modular census, apply for this census modality:

- ◆ Effective use of available budget to collect country relevant information
- ◆ More detailed information available on topics of interest
- ◆ Better training of field staff and possibility of keeping a permanent staff
- ◆ Broadening the scope of the census
- ◆ Decisive step towards the establishment of a system of integrated censuses and surveys
- ◆ Reduced burden on statistical offices and respondents

10.56 In addition to those advantages, for countries that do not have a functioning agricultural statistics system, this modality being a 10-year integrated census/survey programme⁶², lays the foundations for the creation of such a system to *produce a regular flow of basic data*. It will allow the generation of 65% of the Minimum set of core data recommended by the Global Strategy⁶³ and will also provide basic data for monitoring the relevant Sustainable Development Goals (SDGs). Finally, AGRIS is expected to generate the flow of quality data required to monitor

⁶² Some countries may have 5-year census programme instead of 10-year programme. In this case, the implementation of AGRIS should be adapted to this particular situation with possibly more frequent implementation of the rotating thematic modules.

⁶³ See WB, FAO Global strategy, 2010

regional policy frameworks, such as the African Union Comprehensive Africa Agriculture Development Programme (CAADP).

10.57 The structural data collected through the rotating thematic modules will be more frequently updated, allowing a better monitoring of changes in some aspect of the agricultural sector without waiting another census in 10 years.

10.58 This modality is also expected to facilitate the funding of the census/survey programme by spreading the total cost over 10 years. Instead of concentrating the effort of mobilisation of large amount of funds every 10 years, this modality should require a relatively more limited amount to be disbursed annually.

10.59 Most of the **limitations** of the modular census also apply to this modality, particularly:

- The risk of expanding too much the census core module resulting in high cost which will reduce the relative benefits of this census modality.
- The challenge of conducting the census core module and AGRIS annual production module at the same time in countries where this is relevant. This requires survey planning and sampling capacity to define the process with clear instructions for field staff prior to data collection.
- The limitations in terms of cross tabulation between variables in the core and variables in the rotating thematic modules or between variables in different rotating thematic modules not conducted jointly.

10.60 In addition to those limitations one major limitation of this modality is the difference in the reference period for different census items collected in the light census core and the items in the rotating thematic modules spread over 10 years. This factor should be duly taken into account in the analysis and will result in limitations of cross tabulations.

10.61 The need for maintenance and updating the sampling frame is also more important since the frame will become gradually obsolete over time and a mechanism should be put in place to ensure its validity.

10.62 In countries where funding is mainly from external sources, there may be budgetary and other administrative constraints for commitments over such a long period as 10 years. Most externally funded census projects have a duration ranging from 2 to a maximum 5 years.

10.63 An effective implementation of this modality will yield substantial benefits in countries where there is a good strategic plan (like the Strategic Plan for Agriculture and Rural Statistics-SPARS) to ensure that the combined census and surveys will generate most of the priority data needed for users.

10.64 A major **requirement** is a strong political support to establish a functioning agricultural statistics system in the country and availability of funds for the integrated census/survey programme as a package for 10 years.

10.65 The availability of field staff with required level of qualification that can be mobilized to conduct rotating modules and surveys is also an important requirement.

CHAPTER 11: USE OF REGISTERS AS A SOURCE OF CENSUS DATA

Description

11.1 Agricultural Censuses are carried out in most countries as a comprehensive statistical data collection regardless of whether a complete or sample enumeration is used. However in the recent years a growing number of statistical offices, particularly in developed countries, are moving towards more use of data from administrative sources in the statistical data production process. Making greater use of administrative data is a way to reduce the burden on respondents, and generate more frequent data with reduced costs by not collecting again data which is already available through administrative process. A more efficient and flexible use of existing data from administrative sources allows meeting new demands and could improve the consistency and coherence of statistics (R. Benedetti et al, 2010, *Agricultural Survey Methods*). This section discusses the use of data from administrative sources solely or in combination with other data collection methods to generate data items required for the census of agriculture.

11.2 As discussed in WCA 2020, volume 1⁶⁴ “registers and other administrative sources can be used as a source of census data, depending on their content and quality”. This modality of census taking (referred as combined census with use of administrative sources) is new for the WCA programmes. In this census modality, a meaningful part of census items comes from administrative sources, thus reducing the burden on respondents. The cases where only the identification items are taken from administrative sources (such as name, address and location of the holding) are not considered as part of this census modality, in these cases data from administrative sources can be used for construction of the census frame. The most complete use of administrative sources will be when all census items can be based on administrative sources.

11.3 In most countries, several agencies and organisations (such as farmers associations, commodity associations, etc.) keep records related to the activities of their members or beneficiaries. The information may be collected during the registration and updated during ongoing interactions with members. Every time a customer approaches the organisation, such as applying for a subsidy or declaring his/her tax, the customer has to provide data related to his/her activity.

11.4 There are several definitions of administrative sources for statistics in the literature and a more detailed review of definitions can be found in (Global Strategy working paper No3, October 2015, *improving the methodology for using administrative data in an agricultural statistics system*). The UN (UN, 2011, *Using Administrative and secondary sources for official statistics*), provides the following definition: “Administrative sources have traditionally been defined as collections of data held by other parts of government, collected and used for the purposes of administering taxes, benefits or services”. This means that, they are susceptible to change in policy and they may be affected in terms of coverage, definitions, thresholds, etc., or possibly even abolished completely. This definition focuses on information arising as a by-product of the administration of government monitoring programmes and regulations.

11.5 The main distinguishing feature of this census modality is that meaningful part of the census items for the entire population of the census of agriculture or for part of it comes from existing administrative sources created for non-statistical purposes. The data could come from one or several administrative sources, it could be also used in combination with field data collection. This modality differs from the other three census modalities discussed in WCA 2020,

⁶⁴ FAO, 2015, paragraph 4.9

where the possible use of administrative registers and other sources is limited mainly to the establishment or update of the census frame.

11.6 An important feature of the data from administrative sources is that the information is not primarily collected for statistical purposes. In addition, administrative sources may be selective or may target specific population. Also, during the processing the data owner follows specific rules linked to the primary purpose of the register/source, especially in relation to collecting, editing, checking and correcting the data. Thus the definition of the population of interest and the data collection protocols is out of the control of the census office.

11.7 Another important consideration to be taken into account is that parts of the information in administrative sources could be of low importance for the administrative purpose which would usually result in lower statistical quality⁶⁵.

11.8 There is a substantial difference in the organisational approach of the census when using administrative data as compared to other approaches. As the objects⁶⁶ already exist in the data source and they are not tailored for a particular statistical application, a selection need to be made of objects and variables that are relevant to the census. It may be the case where on the basis of the existing information in the register/source new variables have to be derived. The use of administrative sources implies that the data come first and after that the population and variables have to be defined⁶⁷. In the field data collection based censuses, the definition of population and variables is the first step before the collection of information.

Quality consideration when using administrative data for the census of agriculture

11.9 In most cases, it is not appropriate to derive statistics directly from administrative registers/sources since they are not adapted to the needs of statistics. Having a thorough knowledge about the purpose of the administrative register and how data has been collected and processed is an important step in judging the overall quality of the register in relation to the statistical needs. As already pointed out, it is likely that variables important for the administrative purpose have higher quality than variables that are of secondary importance. The purpose and method used to collect data should also be taken into account during the analytical phase on possible systematic errors or systematic bias in the register (e.g. agricultural holders that do not apply for subsidies will not be included in a subsidy registry). Other important issues in this regard include for example, the existence of a penalty if the agricultural holder does not respond correctly, and the data check performed within the framework of the administrative purpose.

11.10 When deciding to use administrative sources for the agricultural census the following quality aspects need to be carefully considered:

- ◆ **Relevance (content)** of the administrative data sources – the most important features are the definition of the units (e.g. holder or agricultural holding) and their identifier. It is an advantage if there is metadata already available in relation to the register/source.
- ◆ In terms of **accuracy** an administrative source can be considered of good quality if a large proportion of the variables required for the census exists in the register/source and corresponding data are reliable. Possible problems are: *missing data* when some or all characteristics for a given unit are missing; *errors in the variables* when erroneous values for

⁶⁵ Using administrative registers for agricultural statistics - methodologies, techniques and experiences, Karlsson, Ann-Marie

⁶⁶ It is considered that for the purpose of this document an “object” in an administrative source means either an agricultural holding or a holder

⁶⁷ R. Benedetti et al, 2010, Agricultural Survey Methods

certain variables are registered (e.g., when the respondents give erroneous identification numbers for administrative data sources in the questionnaire). These kinds of errors can also be caused by different reference periods used in different systems. When the administrative registers are well maintained and strictly controlled the quality of the collected variables is considered better compared to field data. In some cases, the holders may be motivated to provide exact measurement of the utilised agricultural area or the number of livestock in their administrative subsidy declarations since they may otherwise lose their subsidies. However, in some other cases, this may have an adverse effect since the holder may over estimate his area or livestock number in order to receive more subsidies. One of the important accuracy category is related to the *data coverage*. The administrative sources/registers have to contain relevant information for the units (agricultural holdings) in the census frame. Possible issues regarding **coverage include:**

In terms of Unit coverage:

- ◆ Over-coverage: the source covers more agricultural holdings than the census target population. This case may occur when the administrative source/register contains agricultural holdings that are out of the scope of the census (for example holdings under the threshold of the census). This problem can be easily solved by filtering out these units.
- ◆ Under-coverage: the source covers less agricultural holdings than the target census population. This case may occur when the administrative source/register does not contain all agricultural holdings of the census population, for example, due to higher threshold applied than those used for agricultural census. Under coverage may also occur when newly created holdings belonging to the target census population are not included in the administrative source. In this case information may be found in other data sources or data related to the new units may be collected on the field.
- ◆ Multiple listings: some units are present more than once in the source. Multiple listings can be prevented by the use of a unique identification code for each holding and regular checks on some key identification information such as duplication in names, addresses and postal codes. Most common reason for possible duplication in a register/source is partnerships such as between father and son where both partners are registered for different support programmes.

In terms of Item coverage:

- ◆ Misclassification: the information does not allow for the required breakdown and/or there are errors in classification variables. An example is a possible classification problem when pigs are classified by age in the register, whereas the required classification in the census is by weight. Another example is when the division of cows into dairy cows and other cows is not available in the bovine register or the age groups in the register are different from what is required in the census. These issues should be solved by harmonisation of classification systems. Another possibility is to build a statistical model to reclassify categories.

Box 11.1 Country examples: France - Agricultural census 2010, use of National register for identification of bovine animals.

The data from the *base de données nationales d'identification* (BDNI) were used to obtain information on bovine herds. This allowed for a standardised description of the bovine population on 1 November 2010. For this purpose, the farmer's identification number was collected during the field data. All the information on the age, sex and breed of cattle is included in the BDNI. The distinction between dairy cows and suckler cows (as required in the census questionnaires) was made on the basis of the breed of each cow. Lists were prepared with dairy breeds (such as ABONDANCE, ARMORICAINE, AYRSHIRE, BLEUE DU NORD, BORDELAISE, BRETONNE PIE NOIRE, etc.) and suckler cows breeds (such as ANGUS, AUBRAC, AUROCHS RECONSTITUE, BAZADAISE, BEARNAISE, etc). Thus, the distinction was based on these lists.

- ◆ Completeness is another important dimension to be analysed. As stated in paragraph 5, a meaningful part of the census items should come from administrative source. The number of items that could be obtained from the administrative sources in percentage of total number of required census items should be analysed in the light of changes in the organisation of work and IT related (see section 2.4.2) issues needed when replacing partly the field data collection with administrative data.
- ◆ Unreported events: data related to the reference period is not available in the source referring to an event from which parameters are to be derived: e.g. births, deaths or loss, sales or change of holders etc. of livestock. This may result in under- and/or over-estimations of the variables. These kinds of errors cannot be excluded but can be detected by handling several data sources.
- ◆ The information from administrative sources has to be **coherent and comparable with data from other sources or over time**. In most cases an administrative register will need to be integrated with an existing frame for the census to provide data on a subset of the population or data on some variables in a study domain. This means that the integration phase is crucial for achieving good quality. Using common definitions, classifications and methods is important to ensure proper integration. It is not always easy for the Statistical Office to influence the definitions used in administrative registers/sources, but they need to be checked and monitored in order to evaluate their impact on statistics. The process of converting from administrative units (legal units, tax units, claimants, etc.) to statistical units (enterprises, holders, households etc.) can be quite difficult conceptually, and often involves some form of modelling (UN, 2011). One possible difference in definitions is the case of the beneficiaries/agricultural holders in a subsidy system and the holdings in the census. There are cases where they do not have a perfect match (e.g.: one holding may correspond to two or more beneficiaries, when different household members apply for aid, see the example for Sweden below). Another possible difference is when the reference periods are different. One typical example is the Organic Farming Register in the EU countries. The exact date is different for different holdings and depends on the date when the certification body staff have visited the farm for certification. Comparisons of the data and adjustments can be done using another administrative source. Differences in the definitions of variables between administrative and statistical systems are also likely to occur due to differences in needs and priorities between the statistical and administrative use. Another aspect to be checked is the classification systems used within administrative sources that may not be applied at the level of detail required for statistical purposes. Concerning comparability, or the possibility to compare results over time, problems might occur. Statistics based on administrative registers/sources are dependent on changes that the statistical bodies may not be able to predict (UN, 2011).
- ◆ Swedish example on integrating registers with a census in the Farm structure Survey (FSS) 2007 (see country examples in annex)
- ◆ The **timeliness** dimension when using administrative data source is also very important. It is often indicated as the time difference between the reference period and the availability of the results. An analysis is needed on whether data from the administrative source/s could be obtained and integrated into the agricultural census database, well before the results of a census with field data collection.
- ◆ **Accessibility** in terms of physical access to the information in the administrative source is also a very important issue. The software used for the administrative register and those used for the agricultural census should use compatible data formats allowing direct transfer of data from one to the other. If the administrative data is in paper forms, its use for the census could not be possible.

Ways of using administrative registers as a source of census data

11.11 As for the other census modalities, the starting point is to define the data content of the census in terms of **data items to be covered**. The next step will be to consider alternative modalities for conducting the census, including the use of registers as a source of agricultural census data modality.

11.12 Possible ways to use administrative data for agricultural censuses are as follows:

- ◆ **Split data approach:** Replacing the data collection on some of the characteristics for the whole population called split data approach (source: Using Administrative and Secondary Sources for Official Statistics - A Handbook of Principles and Practices, United Nations Economic Commission for Europe, 2011). This approach is more commonly used in cases when the target population is based only on the administrative/statistical register (see country examples below). "Instead of providing all of the variables for part of the population, as in the split population approach (see below), under the split data approach, administrative sources are used to provide some of the variables for all of the population. The split data approach does not, therefore reduce the number of questionnaires or interviews required to collect the data, but does reduce the volume of data to be collected in each questionnaire or interview. It is usually most relevant for large and complex data collections where many variables are required, hence the example of the agricultural census. Administrative data and those collected through questionnaires need to be integrated for each individual holding in order to produce the data set used for statistical outputs." (adapted from "Using Administrative and Secondary Sources for Official Statistics - A Handbook of Principles and Practices", United Nations Economic Commission for Europe, 2011). This approach relates mainly to compulsory registers and all those cases where the support for agricultural holdings is based on application in an administrative system. The most frequently examples for this type of use are bovine/veterinary register, certified organic production register, subsidy system, rural development programmes or projects. Almost all EU countries apply this approach in their agricultural censuses.

Box 11.2 Country examples: Use of administrative registers as a source of census data

Netherlands The agricultural census frame for AC 2010 is the administrative farm register (AFR) of the Ministry of Economic Affairs, Agriculture and Innovation, held by an executive service of the Ministry. Farmers have to register by law. The AFR contains names, addresses and other characteristics of holders or holdings and a unique registration number. The agricultural census applies higher threshold than the AFR, thus only agricultural holdings meeting the definition of a holding in the agricultural census and above the threshold are taken into account. This threshold is applied to separate professional from hobby farmers, and to minimise processing burden. Information on the census items existing in the AFR is taken directly from the register for the whole census population.

Slovenia, AC 2010: The list of agricultural holdings for AC 2010 was obtained entirely from the Statistical Farm Register (SFR), the SFR was fully updated before the list was made. All agricultural holdings in Slovenia were surveyed. The Statistical Farm Register was established after the AC 2000 in order to have a stable sampling frame for all agricultural surveys. It has been operational since 2004. The register is updated twice a year (February/September), which enables the statistical office to have an updated sampling frame for the sample surveys in June and December. Results from all statistical surveys as well as IACS data are used for updating the register. All the addresses of the holdings were updated using the Register of Territorial Units. Information on the census items existing in the SFR is taken directly from the register for the whole census population.

- ◆ **Split population approach:** Replacing the data collection on all census characteristics for a subset of the census population, called split population approach (source: Using Administrative and Secondary Sources for Official Statistics - A Handbook of Principles and Practices, United Nations Economic Commission for Europe, 2011). Data from administrative sources are used for holdings where these data are of sufficient quality, and other statistical sources are used for the remainder of the holdings. In practice this case is not commonly used for agricultural censuses. However, there can be one or more specific groups within the target census population which are strictly regulated hence all the required information is registered continuously, such as the largest holdings or holdings producing specific crops or livestock or applying specific agricultural production methods (e.g. certified organic farming).
- ◆ **Combined split data and split population approaches:** Another form that combines split data and split population approaches is also used where administrative sources replace the field data collection for some of the variables for part of the census population. This case relates mainly to optional registers or those cases where the registration is limited, based on particular characteristics (e.g. territorial, type or size of activity; legal status of the holding). The most frequently used examples for this approach are area payment support programmes (where only those holders whose area is over a certain threshold apply for subsidy), register of cereal growers (limited by the type of activity), orchard register (which contains only market-oriented fruit growing areas) and vineyard register. (Country examples: Hungary, France).
- ◆ **Pre-filling answers in the questionnaires** which are to be checked by respondents during the census. This is quite commonly used approach and usually goes together with the use of CAPI. Any kind of administrative data can be pre-filled in the questionnaires allowing the holders the opportunity to correct erroneous entries. Pre-filled questionnaires have three main benefits:
 - They help reduce the burden on data suppliers by saving them time (assuming that checking and correcting is quicker than finding and entering data)
 - They allow to check the quality of the administrative data
 - They are very flexible, particularly where the coverage of administrative data is not as complete as would be required for the other ways of use discussed above. They allow easy data revisions/changes and adding additional information.

The main disadvantage is the risk of bias introduced because some respondents may simply accept the pre-filled data without checking them, or may choose not to spend time correcting errors⁶⁸.

Country example: Austria, AC 2010, use of administrative data to pre-fill the questionnaires – Link

- ◆ **Totally replacing the census data collection**, on all census characteristics and for all units in the census population with data coming from one or more administrative sources. This type of use was not very common at the time of preparing this publication. One reason is that there are some variables needed for the census of agriculture that are not part of any register or administrative records and the administration cannot afford to overburden the registers only in order to satisfy the statistics.
- ◆ There are several other uses of administrative data in the census which are not considered as part of this modality but which are very commonly applied. They are discussed in other sections of this document:
 - ◆ Build/update the (sampling) frame (used for census or for sample survey) (see Chapter 12 Mapping/frame building).
 - ◆ Imputations in case of non-response (see Chapter 19 on Data processing).
 - ◆ Validation of the census data (quality control) (see Chapter 19 on Data processing).

⁶⁸ Using Administrative and Secondary Sources for Official Statistics - A Handbook of Principles and Practices, United Nations Economic Commission for Europe, 2011

Steps for the implementation of the combined agricultural census modality

11.13 The first step before performing any detailed work on the quality of the administrative source/register is to conduct an assessment of the usability of the source/register. This assessment includes collection and analysis of information about the owner of the administrative register/source, the legal, organizational and technical possibilities to access the data and confidentiality issues. As mentioned earlier, the purpose of the administrative source/register should be studied. Next step would be to undertake a thorough analysis of the quality of the administrative source (see para 10).

11.14 To ensure a successful implementation of a combined census with use of administrative sources several tasks are to be fulfilled:

- ◆ Legal basis: An analysis should be done on the kind of legislation needed to allow access to, transfer and use of administrative data at unit level for statistical purposes as widely as possible. Some countries include this option in their statistics law as it regulates the data collections and data transmissions, including keeping registers, mandatory provision of its content and for statistical purposes. If there is a specific law or other type of regulation put in place for the production of the agricultural census, it could be used to also specify under what conditions relevant administrative sources/registers are to be used. This might include paragraphs on:
 - Purpose of the use of the administrative registers.
 - Names of registers and names of variables that should be used.
 - Reference periods of the information in administrative registers and dates when the information in the registers should be made available.
 - Data protection and confidentiality. It is likely that the legal framework regarding confidentiality will differ between statistical and administrative organizations and it is important that the confidentiality is protected when the information is used for the census. This should be clearly regulated in the law.
- ◆ Consultations between owner and user organizations are needed to understand the opportunities and difficulties. The most important issues to be clarified are the definitions used, the scope and coverage, reference period/s of the variables, identifiers – how are they constructed, are they used only in this register or are common for all registers in the country-, links with other administrative sources. In some cases statisticians have to convince the owners of administrative data to adapt definitions and categories used because of statistical considerations in creation and in development of administrative databases. The best option would be when the owner of the administrative source consults the statistical authority on eventual changes or the intention of establishing a new register. The organizational and technical frameworks are important. Even if a law is in place, it is likely that a written agreement is needed between the organizations co-operating. Such an agreement might include names of contact persons, detailed timeframes, detailed information on the registers, technical standards and ways of co-operating when for example questions on quality or definitions occur. The information in the register needs to be in such a technical format that it is possible to use. If, for example, the information is only available in hard copies, it will most likely be difficult to use. There must also be technical possibilities to transfer the information.
- ◆ Public support: It is important to make clear the differences between statistical and non-statistical utilization of administrative data files both in professional and public groups of society. The public needs to appreciate and understand the benefits of using register sources for statistical purposes in terms of reduced burden for respondents, more optimal use of available information, thus lower cost, faster processing, improved timeliness of statistical data.
- ◆ A good organisational way would be to design a government-wide project well in advance, outlining the responsibilities and the necessary work as follows:

- Make an inventory of all available administrative data sources including the evaluation of its content in terms of usability and quality. It means not only identifying the administrative sources but also checking the consistency, the definitions used, the reference periods applied and the overall quality of the administrative data sources. During the preparation phase it is advisable to make a retrospective comparison on how the units from the selected administrative register comply with the observation units of the census, what were the changes in the definition over the time, etc.
- Develop the content and the conceptual framework for the utilization of administrative records for the census.
- Decide on what indicators are to be produced from what kind of data sources. There are several possibilities:
 - ◆ Use of only one administrative register (e.g. IACS register in the EU countries) in combination with census data collection.
 - ◆ Use of two or more registers, each register providing part of the required variables. In this cases the common identifier is of crucial importance. In addition, a problem with different reference periods used for the different registers could appear (e.g. several registers were used in Denmark, there was a problem with the data from the organic farming register because of different reference period used). The use of several administrative sources could also be combined with field data collection
 - ◆ Determine step by step how the data sets are to be prepared for linkage. A procedure should be established starting with :
 - What identification key will be used for the linking. It is necessary to map the commonly used identifiers such as business ID, social security ID, or subsidy registration code. In lack of these unique identifiers statisticians have to solve the matching problems collecting administrative IDs during previous surveys or using complex compliance e.g. name and address together or matching models .
 - How to deal with non-matching records. Part of the units (agricultural holdings) can be directly linked between the databases (1 to 1 linkage), as already mentioned, this record linking is much easier if a unique identifier exists. However there will be a lot of units where the matching is not so clear, mainly where several units from the administrative register correspond to one holding in the census frame or in case of one unit from the administrative register corresponding to several holdings. The solution to these problems have to be based on the local peculiarities.
 - Develop the synchronization relations of information systems and the commonly accepted data management and data security regulations.
 - Develop the communications strategy of the register-based census. Great emphasis should be placed on dissemination of statistical culture, thereby increasing the public confidence in the statistics.
 - Plan the budget for the particular preparatory work related to the use of administrative sources for the census (e.g. assessment of the content and quality of the administrative source, technical solution related to the access and use of the data, etc.) and provide the necessary IT resources.

Advantages, limitations and requirements of this modality

Advantages

11.15 The main advantages of using administrative data for census of agriculture are:

- ◆ As indicated in paragraphs above, the biggest advantage of using administrative sources to replace the census field data collection is the reduction of cost of census data production in addition to reduction of the burden on respondents. If data from administrative sources only are used the costs of the census will be substantially reduced. However, in the case of a combined census, due to the more demanding work on technical integration of various data sources, the costs can also increase. In addition, the initial investment in building and

maintaining the registers and a high quality IT system need to be taken into account and may be beyond the capacity of many countries.

- ◆ By combining the data collected in the field with the data from one or more administrative sources, new derived variables can be created, which would be difficult to collect with the questionnaire. In this case it is important to determine the priority between the different sources (according to the relevance of variables and the quality of the data)
- ◆ This modality could make possible the compilation and publication of more detailed statistical indicators, more frequently and faster.
- ◆ When data on the entire target population is included in the administrative sources there is no situation of unit- non-response. When using administrative sources as a partial data source, the non-response rate can be significantly reduced. Missing data from the field data collection can be produced through different imputation methods (hot-deck, averages, etc.).
- ◆ The use of administrative data sources for the census could significantly improve the quality of the source and leads to a substantial harmonization of certain information between different institutions.
- ◆ As a result of more efficient and faster operation the public perception of statistics may become more favourable.

Limitations

11.16 Disadvantages and difficulties of using the administrative data source in the census include the followings:

- ◆ In the absence of legislation or when no unique identifier is available to link records from different databases.
- ◆ Sometimes even if the legal background exists it could be very difficult or even impossible to establish a good cooperation with register owners or the cost for the access to the administrative data could be too high. The best solution is to make a provision on this matter (cost for the use of administrative data) in the legislation, preferably free of charge as this can be considered as a public good.
- ◆ In case of different population coverage the data of the administrative source can be used for pre-filling the questionnaires or replacing the characteristics only on the common population of the census while the other units need to be enumerated.
- ◆ Incoherence of concepts, definitions, classification systems and reference periods could make the use of administrative sources difficult. If the differences are so significant, meaning that the administrative data cannot give a good estimation of the required indicator, this data source should not be used. However, it can be still useful for updating the census frame or check the results at aggregated level. In some cases the problems are solved with data editing, but this can become more challenging.
- ◆ Problems related to linking data from various data sources: the links between the units can be very difficult or almost impossible: e.g. the lack of common identifiers, obstacles related to IT issues; some observation units in administrative sources do not correspond directly to the definition of holding. Finding the best matching or aggregation of units can be the solution for this problem.
- ◆ Problems related to data quality of the source. If the data quality cannot be improved by statistical tools, the use of this source should be limited to updating the census frame and aggregated level comparisons. If there is a general lack of trust in the quality of the source or there are risks concerning the stability of the source to political changes then partial testing (piloting) can be done in order to gather experience from the field.
- ◆ Timeliness and punctuality: the final validated data in the source may not be available on time to meet statistical deadlines or may relate to a period which does not coincide with the statistical reference period. This limits the usefulness of the data source but the database of a previous period can still be used for updating the frame.

- ◆ In case of abolition of an administrative source, it is difficult to provide comparable statistical data series. A missing source can be replaced with an additional survey or the abolition of variables, but in any case there is a change in the methodology and thereby a break in the time series .
- ◆ Sometimes the owner of the administrative source makes some substantive or technical changes which is not detected immediately. If the Statistical Office is not notified, the change can have an impact on the technical work or quality of the data.
- ◆ Coverage problems may be revealed by combining data from several registers. Comparability over time is strongly influenced by the change in the level of coverage in the different years and can give misleading results.

Requirements

11.17 This modality should be considered in countries with well developed administrative systems and adequate IT infrastructures. The most important requirements for the use of this modality include the following:

- ◆ Availability of relevant Registers and Administrative database (s) with good quality data at individual holding level, clear and harmonised definitions and appropriate frequency for data update
- ◆ Good IT infrastructure is a pre-condition. It must be noted that the IT preparation for this modality could be quite long because of the need for preparation of special software for data transfer and data matching. In this regard, a good planning of activities and their sequence is of critical importance. Availability of sufficient competent experts with good IT infrastructure knowledge and database management skills at the initial stage of the census preparation is also very important. The skill mix should also be considered. When using administrative registers fewer enumerators but more statisticians and IT-specialists will be needed. It should be kept in mind that the integration of administrative data sources in the census demands more time spent on methodological work and knowledge related to the new techniques of combining data
- ◆ The public approval is important. The public needs to appreciate and understand the benefits of using register sources for statistical purposes.
- ◆ Availability of a good legal basis and governance infrastructure, involvement of public authorities and administrative sources owners, established system for data control. Whenever possible, all administrative sources must be established on the basis of national legislation which ensures stability and allows the use of existing administrative sources for statistical purposes rather than re-collecting data. The legislation for data collection should regulate continuity, data control, reference dates, coverage and completeness of the source and methodological bases. Documentation on the data source should be accessible; data should be in a user-friendly form. The statistical authority must have the right to access administrative data at unit level and link them with other registers for statistical purposes. In this respect the availability of an Agreement established between the census office (user) and administrative body (owner) is critical. Once data have been processed, they must not be used for purposes other than statistics and research (the principle of "one-way traffic")⁶⁹.
- ◆ Unified identification system is needed. Since the data incorporated in the agricultural census are from different registers, it is good to have a unified identification system through all data sources. Without such a unified system it is very difficult to link data between sources. The data linkage must be possible at individual level⁷⁰ (holding or holder).

Other country examples: Austria, Finland, France Hungary, Netherlands Denmark, Norway – Link

⁶⁹ Use of administrative sources in agricultural statistics; what we gain and what we lose, Simon Plešivčnik, Aleš Krajnc, paper presented at ICAS VI

⁷⁰ See footnote 25

References and additional reading

- ◆ Wallgren, A., & B. Wallgren, 2014, *Register-based Statistics: Statistical methods for administrative data*. Wiley Second edition Series in Survey Methodology (New York: Wiley)
- ◆ Wallgren, A., Wallgren, B. (2007) Register-based Statistics. Administrative Data for Statistical Purposes.
- ◆ R. Benedetti et al, 2010, Agricultural Survey Methods, Chapter 2
- ◆ Using Administrative and Secondary Sources for Official Statistics - A Handbook of Principles and Practices, United Nations Economic Commission for Europe, 2011
- ◆ Registered based statistics in the Nordic countries, Review of best practices with focus on population and social statistics, UN 2007
- ◆ GSARS 2015, Improving the methodology for using administrative data in an agricultural statistics system, technical paper on Administrative Data and the Statistical Programme of Developed countries.
- ◆ Use of administrative sources in agricultural statistics; what we gain and what we lose, Simon Plešivčnik, Aleš Krajnc, paper presented at ICAS VI (2013, Brazil)
- ◆ Using administrative registers for agricultural statistics - methodologies, techniques and experiences , paper prepared by Ann-Marie Karlsson, Swedish Board of Agriculture, Statistics Division Marie-Louise Widén , Statistics Sweden, Agriculture, paper presented at ICAS IV (2007, China)
- ◆ Bridging the gap between IACS and statistics, Ann-Marie Karlsson, Swedish Board of Agriculture, PPT

PART THREE Census preparation and implementation

CHAPTER 12

CARTOGRAPHY AND USE OF MAPS FOR THE CENSUS OF AGRICULTURE AND PREPARATION OF FRAMES

A. CARTOGRAPHY AND USE OF MAPS FOR THE CENSUS OF AGRICULTURE

Adequate maps are essential for conducting agricultural censuses and surveys. Maps are used in planning, preparing the frames, organizing and conducting the field data collection and presenting and analyzing results. This chapter presents an overview of cartographic preparations for an agricultural census in order to guarantee adequate coverage, precision and presentation of the collected data. Maps used for statistical purposes include topographic charts, aerial photography, satellite imagery and even sketches prepared to facilitate data collection when no other materials are available. Cartographic materials are costly and their elaboration requires time and special skills. Statistical maps should be based on the cartography carried out by specialized agencies. Most mapping preparations depend on the quality of the basic topographic cartography of the country. The cartographic units of statistical offices must then improve, update and make those maps adequate to be used for specific needs. A permanent cartographic programme for statistical purposes covering agricultural censuses and surveys is a very important tool for increasing the accuracy, timeliness, and usefulness of census and sample survey results.

Introduction

12.1 Geospatial data are now available on hard copy maps or in digital format based on off- and on-line databases (UN, 2015). Good quality maps or digital geospatial information are essential for conducting agricultural censuses since they have an influence on the quality and reliability of census data. Maps are mainly used in census planning, preparing the frames, organizing and conducting the field data collection and presenting and analyzing results. Most countries use hard copy maps or digital geospatial data, in guiding enumerators to villages and other places where holders are likely to be during the field data collection period. These geospatial data are crucial in ensuring full and unduplicated coverage of geographic areas. Maps, increasingly in digital format, are also used as part of the dissemination strategy. 'Statistics compiled from census data can be geographically referenced and provide for methods of analyzing the geographic distribution of those statistics' (UN, 2015).

12.2 Several types of maps (in hard copy or digital format) are used for agricultural census purpose, that is maps related to the agricultural characteristics: topographic maps, road maps, cadastral maps, administrative area maps, maps showing the population distribution, aerial photographs and orto-photos, satellite images, space photographs, land cover and land use maps, soil or geologic maps, etc. Population and Housing Census EA (EA) maps in the form of sketches or digitized and geo-referenced are also frequently used to help delineate the enumerators' areas of work.

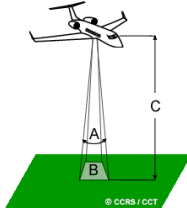
12.3 This section deals with geospatial materials which are usually maps or sketches that can be used for the census of agriculture. These materials were mainly available in the past as printed paper copies. But recent advances in technology and IT have resulted in an extensive use of maps in digital format (Geographical Information Systems). This facilitates considerably the use of maps, allowing changes of scales, geometric corrections, juxtaposition or superposition of thematic maps and layers. These Geographic Information Systems (GIS), require the availability of experienced staff, adequate computers and software capability.

Box 12.1: Scale, resolution and pixel

Scale: The ratio of distance on an image or map, to actual ground distance is referred to as scale. If you had a map with a scale of 1:100,000, an object of 1cm length on the map would actually be an object 100,000cm (1km) long on the ground. Maps or images with small "map-to-ground ratios" are referred to as small scale (e.g. 1:100,000), and those with larger ratios (e.g. 1:5,000) are called large scale.

Source: Campbell, J. B. 2002. Introduction to Remote Sensing. New York London: The Guilford Press

Spatial Resolution



The detail discernible in a satellite image is dependent on the **spatial resolution** of the sensor and refers to the size of the smallest possible feature that can be detected. Spatial resolution of passive sensors depends primarily on their **Instantaneous Field of View (IFOV)**. The IFOV is the angular cone of visibility of the sensor (A) and determines the area on the Earth's surface which is "seen" from a given altitude at one particular moment in time (B). The size of the area viewed is determined by multiplying the IFOV by the distance from the ground to the sensor (C). This area on the ground is called the **resolution cell** and determines a sensor's maximum spatial resolution. For a homogeneous feature to be detected, its size generally has to be equal to or larger than the resolution cell. If the feature is smaller than this, it may not be detectable as the average brightness of all features in that resolution cell will be recorded. However, smaller features may sometimes be detectable if their reflectance dominates within a particular resolution cell allowing sub-pixel or resolution cell detection.

Source: Canada Centre for Remote Sensing

Pixels: Using radio waves, data from Earth-orbiting satellites are transmitted on a regular basis to properly equipped ground stations. As the data are received they are translated into a digital image that can be displayed on a computer screen. Just like the pictures on a television set, satellite imagery is made up of tiny squares, each of a different gray shade or color. These squares are called pixels—short for picture elements—and represent the relative reflected light energy recorded for that part of the image. Each pixel represents a square area on an image that is a measure of the sensor's ability to resolve (see) objects of different sizes. For example, the Enhanced Thematic Mapper (ETM+) on the Landsat 7 satellite has a maximum resolution of 15 meters; therefore, each pixel represents an area 15 m x 15 m, or 225 m². Higher resolution (smaller pixel area) means that the sensor is able to discern smaller objects. By adding up the number of pixels in an image, you can calculate the area of a scene. For example, if one counts the number of green pixels in a false color image, one can calculate the total area covered with vegetation. **Source:**

http://earthobservatory.nasa.gov/Features/RemoteSensing/remote_06.php



12.4 A first step for the use of maps⁷¹ is a comprehensive inventory of available material that could be used for agricultural census purposes. In fact, the main task in cartographic preparations for an agricultural census or survey generally consists of adapting, revising and updating available maps to the census or survey requirements.

12.5 Given its importance for data collection, a large proportion of the cartographic preparations for an agricultural census or survey consists of delineating and identifying the enumerators' areas of work, i.e., the EAs. In many countries EA maps are prepared as part of the cartographic work of the Population and Housing Census (PHC). *The UN Handbook on census management 2016* provides detailed guidelines on mapping activities for PHC which are largely relevant for the Census of Agriculture for which the main activity consists of adapting and updating EA maps. Updates may include the creation of new EAs, splitting of areas where the number of holdings exceeds or the geographic extent exceeds the capacity of an enumerator, and merging very small EAs in terms of number of agricultural holdings or geographic extent. In some countries, such as Brazil, the cartographic work of the PHC is conducted for both PHC and

⁷¹ In the rest of this section the term map will be used in the sense of geospatial information in hard copy or in digital format.

Agricultural Census.

12.6 The largest proportion of the cartographic support for an agricultural census conducted when sampling is used is the preparation of the sampling frames corresponding to each sample selection stage, including detailed mapping to support the field data collection.

Purpose of maps

12.7 Maps for conducting agricultural censuses have three main purposes: (i) census planning and frame preparation; (ii) Organization, conduct and supervision of field data collection; (iii) Presentation and analysis of results.

◆ **Census planning and frame preparation.** The cartographic material used are usually small-scale topographic maps, at scales of 1/50,000, 1/100,000 or smaller⁷², showing political and administrative boundaries, location of cities, towns and villages, mountains, plains, lowlands, valleys, rivers, deserts, swamps, transportation lines, and some indication of population density or extent of agricultural areas. They may include data on vegetation, land use or land cover features, and may be satellite images, aerial photos or ortho photos. They should provide the cartographic base for planning and organizing (including budget estimation) for the statistical work, for instance to set up enumerators' assignments, assign geographic codes to proper statistical areas, estimate travel distances and directions, etc. Maps can also be used for the construction of the frames for the census, particularly when sampling is used. For a sample survey, a sample frame is needed for each stage of sample selection, and therefore the appropriate supporting maps are generally of a larger scale than those previously mentioned. They can be used to define the survey area and to improve sample design by providing information for stratification and other auxiliary information. For more information on the use of maps, remote sensing and other cartographic information for frame building see the **Ch 4.2 and Handbook on master sampling frame chapter 4.**

◆ **Organization, conduct and supervision of field Data Collection.** Maps (or sketches) and/or photos for identifying EAs (EAs) are used in the field by census/survey enumerators for data collection. These are large-scale field maps, 1/10,000, 1/5,000 or larger, which should help the enumerator locate the agricultural holders or holdings' addresses to assure complete coverage of areas without omission and duplication. With increasing use of digital maps and hand held GPS during PHC cartography, EAs are more and more digitized and geo-referenced and the location of each holder's housing unit in the EA can be captured as point locations. This can very effectively help the enumerator during the field work for locating the households engaged in own-account agricultural production in rural areas when the Census of Agriculture is conducted immediately after the PHC since there is often no address in many developing countries' rural areas. EA maps will also help determine the best route of travel to and within the EA, (with estimates of distances and directions). According to the **UN 2016**, it is expected that by the end of the 2020 round, most countries will have implemented a GIS for PHC mapping in some capacity. GIS provides a computer-based design of EAs and significant automation of map production tasks. See the **United Nations publication Handbook on a Geographic Information System and Digital Mapping for Population and Housing Censuses**, for further details on GIS mapping. The increasing use of digitized geospatial information and CAPI provides also a powerful tool for monitoring and supervision of field work by showing almost in real time, the progress of each enumerator's field work. Several recent surveys conducted in various countries have demonstrated the effectiveness of these tools for close monitoring and supervision of enumerators performance.

⁷² 1/50,000 means that 1 unit of length on the map represents 50,000 units of length on earth, i.e. 1 cm= 500m.

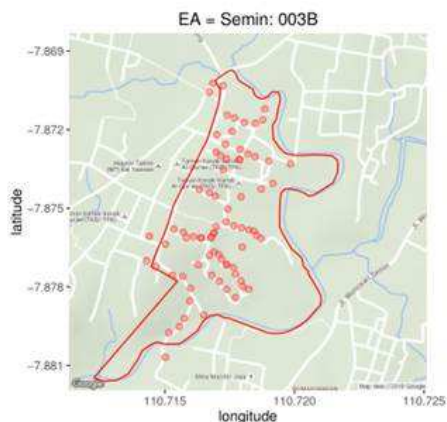


Table 1: Interviews completed on 1/2/2015

teams	enumerators	interviews
Team A	interview_1	3
Team A	interview_2	2
Team A	interview_3	3
Team B	interview_4	1
Team B	interview_5	1
Team B	interview_6	2
Team C	interview_7	2
Team C	interview_8	2
Team C	interview_9	3
Team D	interview_10	0
Team D	interview_11	2
Team D	interview_12	3

Example of digitized EA map showing statistical units with their coordinates and table showing the daily performance of enumerators . Source:TO BE ADDED.....

More information on the use of CAPI in Chapter 18.

EA map symbols should follow cartographic standards and should preferably be self-explanatory, not requiring special complex training instructions for the enumerators. In any case, the use of maps should be an essential part of the enumerators' training.

◆ **Presentation and analysis of census results.** Maps can be used to relate statistical data with the corresponding geographic area, facilitate the understanding of statistics and assure a more extended and appropriate use of data. Maps provide a means by which statistical information can be presented simply and effectively. Thematic maps, Atlases and digital databases produced from the statistical results, are used by many countries (see Chapter 23).

Inventory of available geospatial information and maps

12.8 Most countries use existing geospatial material available from various sources for the agricultural census and do not perform ad-hoc cartographic work. Therefore, the initial work consists of a comprehensive inventory of available maps that could be used for agricultural census purposes. In fact, the main task in cartographic preparations for an agricultural census generally consists of adapting, revising and updating available maps to the census requirements.

12.9 One of the first activities in the planning of an agricultural census or survey should be to explore in detail the feasibility of using existing geospatial information and particularly hard copy maps. It is strongly recommended to prepare an inventory of existing maps including, at least, the following information:

- ◆ Office responsible for the preparation.
- ◆ Date of publication or preparation.
- ◆ Date of the basic photography if made from aerial photos.
- ◆ Purpose of the preparation.
- ◆ Area covered.
- ◆ Scale.
- ◆ Symbols.
- ◆ Projection.
- ◆ Cartographic references.
- ◆ Technology used.

The map inventory should then be evaluated for census use by cartographers and GIS specialists.

Types of maps used

12.10 Many different types of maps can be used for the agricultural census or survey, for example:

- ◆ **Topographic sheets.** The most important maps available in various government branches are general topographic maps that are published in sections called topographic sheets. Most European topographic sheets are on the scale of 1/25,000 to 1/100,000. Less-developed countries generally use smaller scales: 1:100,000 or smaller.
- ◆ **Other government maps.** Maps may be available from government offices involved in land surveys. For example, geological survey maps, coast and geodetic survey maps, topographic and hydrographic survey maps, land-use and land cover maps, conservation and land reclamation maps, armed forces maps, forest and wildlife maps, etc.
- ◆ **Satellite images.** Satellite images (available on paper or on in digital format) are very valuable and provide useful information as they give a detailed and up-to-date picture of the land and can provide information on land use, agricultural patterns and practices, population density and infrastructures. Satellite images are used in a number of countries, for example as an instrument for improving the methods of agricultural statistics data collection. More precisely, satellite images are used for the following purposes:
 - to identify and subdivide the agricultural land (stratify) by intensity of land use and other land cover characteristics and therefore help in the construction of area sampling frames for agricultural surveys; and
 - to monitor agricultural changes by using, for instance, vegetation indexes.
 Recent developments have seen the emergence of some companies in the information technology sector that produce public-access images with global coverage (**Google Earth, Bing**). There are potential uses of these images for agricultural statistics. A major advantage is that they are available and easily accessible, with an efficient interface. Most agricultural areas of the world are covered by Very High Resolution (VHR) images; this is a significant asset, especially for countries that seldom have recent homogeneous ortho-image coverage.
- ◆ **Aerial photography.** Aerial photos can be used to produce, update and supplement census maps. If no map exists for an area, or if the ones available are seriously out-of-date, it may cost less to take aerial photographs than to construct maps. On the other hand, if there is a shortage of resources for taking the photographs and interpreting them, drawing sketch maps may be the best solution. Aerial photos are commonly used for data collection of selected areas (segments) in area sample surveys, as indicated in **Chapter xx**.
- ◆ **Communication maps.** All forms of transportation, land, sea, and air, need maps to show their routes to the public. Quite often such maps are diagrammatic, that is the presentation is very simple. Some of these maps are totally utilitarian in nature as in the case of railroad maps. However, many are good landscape maps, showing patterns of vegetation, types of farming, etc. Maps prepared by airline companies and some road maps usually include scenic and places of historical interest, recreational spots and other information to promote travel.
- ◆ **Land-use maps.** Such maps show the actual and possible uses of land, including both agricultural and non-agricultural (industrial, urban, recreational, mining and lumbering).
- ◆ **Economic maps.** These maps are concerned with the production, transportation and distribution of goods, and are necessarily small-scale maps. Economic maps are likely to focus on a single product or a group of products and are mostly statistical in nature.
- ◆ **City and tourist maps.** Although such maps are primarily intended to motivate tourism, their utility for census purposes should not be overlooked. Besides tourist attractions, such maps also show the road systems of cities and other tourist areas.
- ◆ **EA maps from PHC.** As indicated in **paragraph 12.5** above, EA maps from PHC are widely used as basis for organizing and conducting agricultural censuses and surveys. They are large scale maps and are being increasingly geo-referenced and digitized which facilitate their use.

Timing of cartographic preparation

12.11 As specified above, the cartographic work for a Census of Agriculture mainly consists of adapting and updating existing geospatial information to meet the requirements of this operation. The timing of the cartographic preparations depends on the type of statistical operation (complete enumeration or sample enumeration), the desired geographic precision required for data collection and dissemination, the availability and accuracy of the basic geospatial information of the country, the number of maps needed, and other characteristics of the country like topography and land use.

12.12 The cartographic work should be conducted during the early stages of preparatory census activities. It should start with the inventory of existing maps and the evaluation of their suitability for the Census of Agriculture. The work should be performed by cartographers and GIS specialists which should be part of the core staff of the Census Office.

12.13 The availability of Computer-assisted cartographic systems in a growing number of countries can be very useful to update maps for statistical purposes and should result in gain in time. However, countries are recommended to allocate sufficient head time for this work during census preparation.

Country example: XX - Link

Suggested reading (TO BE UPDATED)

- ◆ *The UN Handbook on census management 2016*
- ◆ United Nations publication *Handbook on a Geographic Information System and Digital Mapping for Population and Housing Censuses, 2016 or 2017*

B. PREPARATION OF FRAMES FOR AGRICULTURAL CENSUS

The purpose of this chapter is to describe the procedures and problems encountered in the construction of the main types of frames needed to conduct agricultural censuses.

The construction of the frame is the most important preparatory activity for an agricultural census. For censuses conducted on a complete enumeration basis, it refers, in most cases, to the preparation of a list of enumeration areas with the approximate number of holdings/holders' addresses in each area. The agricultural census frame is therefore essential for organizational purposes and for ensuring the proper coverage of all agricultural holdings during data collection.

For censuses conducted by sample enumeration, a sampling frame is needed and has to be constructed for each sampling selection stage and a non-zero probability of selection has to be assigned to each sampling unit of the frame. There are two basic types of sampling frames: area frames and list frames corresponding to area sample designs and list sample designs. There are also multiple frame designs that combine an area sample with a list sample design, and for which the area and the list frames should not overlap. The construction of these three types of frames is treated separately.

Geographic Information Systems utilizing topographic charts, satellite images and aerial photos as well as Geographic Positioning Systems may also be utilized to improve the traditional methods of area frame construction and sample selection

12.14 A prerequisite for the organisation of an agricultural census, whatever the modality of implementation is the preparation of suitable frames. The preparation of a frame for an agricultural census requires a large proportion of the total effort, time and resources invested in a census programme. In developing countries it is advantageous to use the opportunity of conducting an agricultural census to prepare an efficient frame which can be utilized not only for the census but as master sampling frame also for subsequent regular agricultural surveys, thus improving the agricultural statistical system.

Definition of a frame

12.15 A frame can be defined as the set of source materials⁷³ from which the sample is selected (UN, 2005). It is the basis for identifying all statistical units to be enumerated in a statistical collection (MSF Handbook 2015). In the case of agricultural census, the basic statistical unit to be enumerated is the agricultural holding. An ideal frame would be a list of all agricultural holdings, based on the operational definition of the agricultural holding adopted by the country, identifying each unit without omission or duplication and without including any units other than agricultural holdings.

12.16 WCA 2020 defines two types of agricultural holdings: (i) holdings in the household sector – that is, those operated by household members; and (ii) holdings in the non-household sector, such as corporations and government institutions. Therefore the requirements for building a frame may vary depending on holdings in the household sector or holdings in non-household sector. The requirements will also vary depending on the modality of implementation selected by a country, classical census, modular census, integrated census/survey or combined census with use of administrative data. Whatever the case, there are three main types of frames that can be used for an agricultural census, *the list frame, the area frame and the multiple frame.*

- ◆ **The List Frame** is a list of agricultural holdings and/or households that can be obtained from agricultural or population censuses and/or statistical farm registers, as well as administrative sources. It is to be noted that the ultimate sampling units are lists of names of holders or households and their addresses, names of holdings and their addresses or location. However, when the list of agricultural holdings

⁷³ Such as maps, lists, directories etc...

and/or households is missing, the list of EAs could serve as a starting point for the development of a census frame.

- ◆ **The Area Frame** is a set of land elements, which may be either points or segments of land. The sampling process may involve single or multiple stages. In most agricultural area frame surveys, the sampling unit is associated with a holding.
- ◆ **The Multiple Frame** In some cases a multiple frame approach is used, in which part of the population is covered by a list frame (e.g. commercial holdings) and the remainder (e.g. other holdings) by an area frame (FAO, 1996b; FAO, 1996c).

For the census of agriculture, the list frame is the most commonly used frame.

Frame requirements for various Census modalities

Frame requirement for a classical census

12.17 As discussed in Chapter 9 the classical census can be conducted by complete enumeration, sample enumeration or a combination of complete enumeration and sample enumeration. For each of these methods, a suitable frame is necessary to ensure full coverage of all holdings in the country. In case of complete enumeration, it is necessary to estimate in advance the approximate location of holders' housing units and to assign to census enumerators well defined areas of work, usually determined with the help of different types of maps and eventually sketches if small-scale maps are not available. The total area of the country is unambiguously divided into identifiable areas in such a way that the enumerators' workloads are approximately equal. These non-overlapping subdivisions of the country are called **EAs (EAs)**. The accurate mapping of the EAs would ensure proper coverage and avoid omissions and duplications. In general, the EAs are defined and delineated in such a way so that the enumeration work in each area can be handled by a single enumerator during the census data collection period.

The agricultural census EAs are geographic areas such that:

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

12.18 In many cases, particularly in developing countries, an **agricultural census frame** is a list of EAs, with the estimated number of holdings in each EA. The EAs often are the smallest subdivisions of the country for which agricultural census data will be available.

12.19 In some countries, the census EAs are defined as subdivisions of relatively small administrative or political divisions (districts, for instance) if good maps are available. In other countries, a village is a well identifiable unit and village maps are available showing boundaries. Then, a village can be, with certain modifications, adopted as an EA provided that its size is compatible with criteria defining an EA. And, in countries where no such maps exist, sketches are used. In other countries, the latest population and housing census enumeration districts can be grouped to form agricultural census EAs as explained in.... above. This latter possibility is often used since, in most countries, for the population census organization and data collection,

enumerator areas (that are different to those of the agricultural census) are defined. The population census EAs are defined as a function of the workload for enumerating the total number of households or housing units with a certain average time for completing a questionnaire, and a certain census enumeration period, factors which are generally different from those of an agricultural census.

12.20 In some countries, such as Brazil, the cartographic work of the PHC is conducted for both PHC and Agricultural Census. The EA sizes are defined taking into account requirements both for the Population Census and the Agricultural Census. (See Box 12.2)

12.21 The possible sources of available information for the construction of an agricultural census frame are the following:

- ◆ The statistical data and maps of the EAs of the most recent population and housing census and a list of EAs along with their number of households/housing units;
- ◆ The statistical data and maps of the EAs of the latest agricultural census including a list of EAs with their number of holdings.
- ◆ Listings with the addresses of holdings not directly associated with holders' housing units;
- ◆ Registers, surveys, cadastral and other cartographic materials, which include listings of holdings and/or holders' addresses or their approximate location;

12.22 In principle, the latest agricultural census (item (i) above) would be the most adequate pool of data and maps to construct an updated agricultural census frame. However, the latest agricultural census data and maps may not be available or, if available, they may be outdated because they are too old or incomplete to define the new agricultural census frame. In such cases, the most recent population census data and maps (item (ii) above) may provide the most adequate data and maps to construct a frame for an agricultural census.

12.23 The construction of an agricultural census frame must also cover the agricultural holdings that are not directly associated with holders' households, such as large plantations or cooperatives (non-household sector). If a list of holders is obtained by screening a list of households or housing units from the population census, it is quite possible that those holdings will be omitted from the list. A special effort is required, therefore, to compile a list of such large holdings from other sources in order to ensure their coverage (item (iii) above). Although the population census may provide very useful data, it

Box 12.2: BRAZIL - Defining EA for the Census of Agriculture

The Brazilian territory is divided into administrative units (Federal District, State, Municipalities, Districts, Sub-Districts, and intra-urban subdivisions such as the metropolitan areas and neighborhoods), whose legal limits are respected by IBGE in conducting the census. Since they are still too large to be covered in such limited time (???) new subdivisions, -the census EAs- are applied. The EAs are territorial data collection units, set up within the same administrative boundaries and other defined, preferably, by reference stable points, with easy identification in the field.

Census EAs

It is the cadastral control unit formed by continuous area, located in a single urban or rural unit, with size and number of households or agricultural businesses previously stipulated. The perimeter of the EA comprises the legally established boundaries and those established by the IBGE for statistical purposes.

The dimensions of these EAs should comply with the quantitative criteria for both the population data collection activities and census of agriculture, as defined in the Table below.

Sector	No of houses			No of establishments			Duration (days)		K m ²
	Min	Av	Max	Min	Av	Max	PHC	AC	
URBAN									
Urbanized	250	300	400				30		
Not urbanized	150	200	250	100	150	200	46		
RURAL	150	200	250	100	150	200	46	60	500

Source: IBGE, Censo Agropecuário 1995-1996/2006.

should not constitute the sole source of information for the preparation of an agricultural census frame.

12.24 The listings and cartographic materials indicated above are increasingly used in developed countries in preparing or verifying an agricultural census frame or even providing census items, but in fact, such listings and maps are usually less complete than those available from the censuses of population or agriculture. Therefore, to a large extent, the construction of an agricultural census frame is determined by the quality, timeliness and coverage of the data and maps of the latest agricultural and population censuses. In a number of developing countries it might be necessary, due to lack of reliable information, to prepare the census frame by conducting a pre-census listing operation. And, it might even be necessary, due to lack of good maps, to prepare sketches for the EAs.

12.25 It is preferable that the EA be small in size, say few hundreds of holdings, as is the case in some countries. In such cases, the holdings will be visible from one point or will be located along a road. Even if they are spread around, their small number should reduce errors in enumeration.

12.26 If large EAs are used, including in some countries as many as 500 holdings or more, spread over several square kilometers, upon arrival in the EA, the enumerator cannot start visiting the holdings without a pre-established order. Without a definite plan of enumeration there is a definite risk that some holdings may be enumerated twice while others may be omitted. For this reason in the case where a pre-census listing operation has not been done, a plan of listing is necessary before the enumerator can start calling on the holdings. If a reasonably good cartographic map is available, the enumerator may start the listing from one corner of the area and proceed systematically, say clockwise until he/she completes the visits to all the households. In the case of urban areas, all the households are usually divided into blocks and these blocks are numbered on the maps with street names or numbers. The listing can be done by blocks, starting from a fixed point of the block.

12.27 However, in most developing countries, in rural areas the houses are not usually arranged in blocks, nor do well-defined streets with names and house numbers exist. The availability of geo-referencing devices and free GIS images considerably facilitates this listing process as explained in point 16 below. In many countries, people of the same ethnic group or families closely related stay in the same compound. These compounds can be numbered and listing of the holdings can be completed by compound. In such listings, the help of the chief of the families in the compound may be obtained. In the list of the households, the names of the heads of households and other particulars to identify the holders living in the household, may be written. If more than one holder exists in a household, the names of all the holders should be written one below the other. It is very important that all households are visited and all holders listed serially. This will ensure enumeration of all holdings and complete coverage. If a pre-census listing have been done, the enumerator will verify and eventually update the list prior to starting the enumeration of the holdings.

12.28 With emerging technological advances, there is an increasing use of GPS devices combined with the availability of free access satellite images and CAPI which considerably facilitate the work of the enumerator in the field. When homes of the households are geo-referenced during the preparation of EA maps and loaded in tablets together with freely available GIS applications such as Google earth or Google map, the enumerator can identify all units to be covered and optimize the way he moves inside the EA in rural areas with no address particularly when he is using a GPS-enabled tablet on which all geospatial information have been loaded.

12.29 Population and housing census data and maps can be used in various ways to construct a frame for the agricultural census and it is important to improve the coordination between the

population and agricultural censuses which in most countries are the largest and most expensive statistical programmes. The use of the population census to prepare the frame of an agricultural census information is particularly useful in countries where most of the agriculture is covered by the rural households.

12.30 The population census cartography, that generally determines the boundaries of the urban, suburban and rural zones, is used in particular to define the coverage of the agricultural census frame. It is often convenient to define the agricultural census EAs by grouping contiguous population census EAs within each political subdivision and urban or rural zones. In rural areas, if the number of holders' housing units can be estimated from the total number of occupied housing units by EA, then suitable groups of contiguous population census EAs can be used to define the agricultural census EAs.

12.31 In urban areas where the proportion of agricultural holders' households is generally low, it may be useful to define provisional EAs by grouping contiguous population census EAs for the purpose of organizing the field screening that would permit the identification of holders' households and the definition of the final agricultural census EAs. It should be noted that the agricultural census covers only a small proportion of urban households.

12.32 The EAs prepared for carrying out the latest population census may not have always been corrected and adjusted on the basis of the information collected during the census. This is also often the case for the agricultural census EAs. In these cases the EAs should be updated if it is considered worthwhile.

12.33 Classical Population census data, in most cases, do not allow a direct link to be established between agricultural holdings and households and are limited to information that allow to identify the population whose main activity is agriculture within the context of a fairly short time-reference period.

12.34 However, a growing number of countries are including questions aimed at identifying agricultural holders' households. The FAO&UNFPA 2012 Guidelines for linking Population and Housing Censuses with Agricultural Censuses provide detailed discussion on the issues and recommendations on questions that can be included in a PHC in order to obtain an effective frame for the agricultural census or conducting both censuses simultaneously.

12.35 Whenever possible, it is advisable to coordinate the construction of the EAs of the population and agricultural censuses, or to elaborate them jointly, because this will save considerable resources. These savings are particularly significant for countries that can dedicate only very limited resources to national statistical programmes, and to countries where a high proportion of the population is in the agricultural/rural sector. In these cases the only feasible way of conducting an agricultural census by complete enumeration or based on a list sample design maybe to closely link it to the population census. (See example for Brazil in paragraph xx).

12.36 It may be convenient in some cases to improve the boundaries of the latest agricultural census EAs, or improve the coverage of certain areas of the country by using the population census data and maps. In such cases, the population census is used indirectly to construct the agricultural census frame.

12.37 In order to conduct a census by sample enumeration, as mentioned in Chapter ., there are two basic types of sample designs concerning the final stage sampling units and their probabilities of selection, namely, **list sample (LF) designs** and **area sample (AF) designs**. The third type (multiple frame) is a combination of the two basic types of frames (LF and AF). The preparation of the frames needed for these two types of sample designs, as well as the preparation of the frames

for multiple frame designs is discussed in the following paragraphs.

Frame requirement for a modular census

12.38 The distinguishable feature of the modular census is the existence of a core module to be conducted on a complete enumeration basis and one or more supplementary modules to be conducted on sample basis, using the information from the core to build the frame for the supplementary modules. Therefore, the frame requirement for this census modality is limited, since it includes a built-in process for generating an appropriate frame from the core module conducted by complete enumeration for the subsequent supplementary modules conducted through sample survey. However, as for the classical census, an initial frame is needed for organizing the complete enumeration for the core module. The initial materials needed are EA maps and indicative numbers of households or holdings for efficient organization of the field data collection for the core module. The points discussed under frame requirements for complete enumeration for classical census apply here.

Frame requirement for an integrated census/survey

12.39 The integrated census/survey modality is characterized by a light census core module to be conducted on a complete enumeration basis and a number of several rotating thematic modules to be conducted annually or periodically on sample basis over a 10 year period through an Agricultural Integrated Survey programme such as AGRIS. The frame requirements are very similar to those of the modular census. As for the classical census, an initial frame is needed for organizing the complete enumeration for the light census core module.

Frame requirement for the modality based on use of registers as a sources of census data

12.40 In the modality based on the use of registers as a sources of census data registers and other administrative sources can be used as a source of census data, depending on their content and quality.. Under this modality, frame information will be directly provided by the registers and administrative sources used if they cover entirely the population of interest. In section.. it is indicated that in cases for which registers cannot provide all the essential items, a combined approach that uses administrative and statistical sources is an option.. In this case the frame requirements for complementary census are identical to those discussed in the modalities above.

Guidelines on building frames for Agricultural Census

12.41 In practice very few countries have a complete list of all holdings available before conducting a complete enumeration census. Therefore, to be able to enumerate all holdings a preliminary frame is indispensable which is made of a set of physical materials (cartographic maps, EA maps with number of households or agricultural holdings, list of farms with addresses from registries, directories, etc) that cover all holdings.

12.42 When complete enumeration is implemented, this set of material providing a preliminary frame will be enough to plan and organize the field data collection as discussed under Chapter 17.

12.43 When sampling is involved the frame requirement is directly related to the type of sampling as discussed in Chapter 13. The three main types of frames that can be used for an agricultural census as specified in **Chapter xx** are, *the list frame, the area frame and the multiple frame.*

12.44 The publication under the Global Strategy to Improve Agriculture and Rural Statistics, Handbook on Master Sampling Frame for Agricultural Statistics: frame development, sample design and estimation, provides detailed guidelines on development of list frame (Ch 5), Area frame (Ch 6) and multiple frame (Ch 7).

12.45 Building frames for holdings in the household sector is much more challenging, given their large number and the lack of up-to-date registry in many developing countries. Holdings in the non-household sector on the other hand, are usually in small numbers and their frames are often built from existing registries or directories etc. Another aspect to consider when preparing frames for the census of agriculture is the distinction between 'urban agriculture' and 'agriculture in rural areas managed by urban households'. In countries where reliable cadastre or land taxes system exist, holders not resident in rural areas may be identified using such system and cross checking with other sources. Care should be taken for not missing out these holdings which may be difficult to identify.

List frame

12.46 As indicated earlier, list frames are the most widely used frames for agricultural censuses.

12.47 In Chapter 5 of the Handbook on MSF, related to list frame, the Handbook discusses (i) the use of population and housing data, (ii) the use of agricultural census and (iii) the use of registers to build a list frame.

12.48 When Population and Housing data is used in a traditional way without specific questions on agriculture, the economic activity status must be considered together with occupation and industry in order to provide an approximation for households involved in own-account agricultural production. However, there are severe limitations upon the use of such limited items which are discussed in FAO/UNFPA, 2011.

12.49 When PHC includes some relevant questions on agriculture, this information can be used to better identify households involved in own-account agricultural production and provide a list of EAs with information on the number of these households. The minimum data items to be included in the PHC are related to whether or not the households are engaged in own-account agriculture production activities. The two basic items are: (i) own-account agriculture production (ii) measure of farm size and the number of livestock.

12.50 Chapter 5 of the Handbook on MSF also discusses the use of business registers of farms to build a frame, including administrative registers of corporations operating agricultural holdings, lists of members of agricultural cooperatives, lists of members of farmers associations, local knowledge and information from extension agents and local authorities.

12.51 In all these cases, there are issues that are discussed in detail in the Handbook on MSF (frame units and population units, multiplicity, imperfections, non-sampling errors) as well as recommendations for maintaining and updating list frames.

12.52 When sampling is involved in the Agricultural Census, the use of the EAs from a population census or the use of the EAs from the latest agricultural census as Primary Sampling Units (PSUs) is a usual form of cluster sampling. It should be noted that although the PSUs are geographic areas, in the absence of cropped areas, the associated probabilities for the sample selection are not proportional to the geographic area of the EA: they are usually proportional to the number of holdings. All holdings are listed within selected EAs and a sample of holdings (as represented by holders) is chosen in the second and final stage. Data collection usually consists of accompanying the holder to his/her holding, measuring the fields and gathering whatever other

data is needed to complete the survey questionnaire.

12.53 The average size of PSUs varies, in general, from 50 to over 200 holdings, of which 4 to 10 are selected for the final sample.

12.54 Some of the problems involved in the use of list frames are the following:

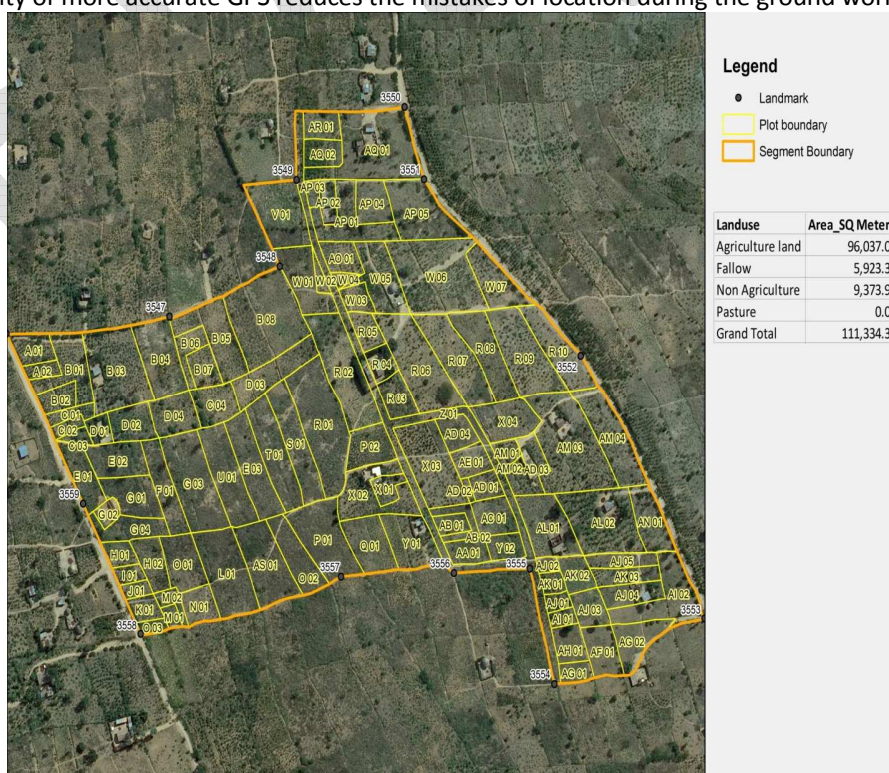
- ◆ In comparison with other sampling designs, a larger sample may be necessary due to the between-cluster and within-cluster variances.
- ◆ It is often not easy (sometimes impossible) to establish the boundaries of the PSUs whether they are villages, EAs or administrative subdivisions.

Area frames

12.55 In Chapter 6 of the Handbook on MSF, related to area frames, the Handbook discusses the main types of sampling units in area frame (segments, points, transects) and related sampling techniques.

12.56 The segments are pieces of territories used as units in an area frame. As a practical rule, the size of segments should enable the groundwork to be performed in less than one working day which corresponds to 10 to 20 plots per segment. Segments can be delimited by physical elements such as roads, rivers or permanent field boundaries. This approach which used by the USA and several other countries (see FAO, 1998) requires a significant initial investment.

12.57 Segments can be also defined with reference to a regular grid which is cheaper. This approach was chosen by Spain and other countries (see FAO, 1998). Comparisons between the two approaches (Gonzalez and al. 1991) conclude that the standard errors are very similar. Therefore some countries chose segments with physical boundaries with the argument that it reduces ground survey mistakes while others prefer regular grid since it is cheaper and the availability of more accurate GPS reduces the mistakes of location during the ground work.



Example of a segment with plots. Source: Rwanda Seasonal Agricultural Survey

12.58 Another type of units used in area frame and discussed in the Handbook on MSF are points. In point sampling, the final sampling unit is a point and the reporting unit is the holding associated with the point. A grid can be used and the points can be at the intersections of the grid lines, or in the middle of each grid square. Area frames of points have been used widely for forest inventories and there are several examples in Europe of use of points for agricultural and land cover surveys. (see FAO, 1998). Two stage sampling schemes are usually used with 10 to 36 points (SSUs) per PSU or cluster which corresponds roughly to the size of a segment. Points can be clustered or unclustered and it is indicated that in European conditions, unclustered points in a two-phase sampling appear to be more efficient than clustered points. However, this does not necessarily apply to developing countries where operational cost may be a major constraint and clustered points may be more efficient. It is also indicated that data collection and processing is easier for points than for area segments and the cost efficiency is generally superior.

12.59 Transects (lines of a certain length) are another type of area frame unit often used for environmental and forest surveys. But the number of operational examples is limited even if the application of this approach for estimation of agricultural land and nomadic livestock can be considered (see GS guidelines on enumeration of nomadic and semi nomadic livestock).

50. The Handbook on MSF discusses ways of linking area frames with list frames from census or administrative information through EAs. An EA can be considered as a large segment of an area frame. Subsampling can be used by building a list of farms that have most of their activities in the EA or sampling farms by points.

12.60 In all these cases, there are issues that are discussed in detail in the Handbook on MSF as well as specific recommendations.

Multiple frames

12.61 Multiple frame sampling is discussed in Chapter 7 of the Handbook on Master Sampling Frame. It involves the joint use of two or more frames. For agricultural purposes, this usually involves the joint use of area and list frames. In many developing countries there is usually a large number of farms that have small land areas but cover a wide range of items, with an even geographic distribution and a small number of commercial farms producing large amounts of some items or producing rare items. Therefore, when area frame is used, the frame covers the entire farm population and land and is statistically efficient for small farms, but large sample sizes are necessary for population with rare items and with skewed distributions. On the other hand, given the changing nature of the farm population, the list frames can become obsolete rapidly- and thus incomplete in their coverage of the farm population- when data collection actually takes place. In multiple frame sampling, the lists and area frames can be developed independently and samples can be selected separately from each frame in a single or in multiple stages.

12.62 For an agricultural census based on a **multiple frame design**, any duplication (overlap) of list frame elements in the area frame must be removed, an operation that requires special attention and resources.

12.63 The case of a relatively short complementary list frame, enumerated completely, used with an area sample is the multiple frame described in the Handbook on Master Sampling Frame since these are generally the most adequate multiple-frame methods applicable in developing countries (7.61 adapted).

12.64 The Handbook provides detailed discussions on issues and statistical methods for deriving estimates in using jointly the two frames.

Using new technology for building frames

12.65 Chapter 4 of the Handbook on MSF reviews current technologies and provides guidelines

on their use for developing area frames and list frames. The tools discussed include Global Navigation Satellite Systems (GNSS) better known as GPS, the Geographic Information System (GIS), and Remote Sensing.

12.66 GIS are tools for collecting, storing, retrieving, transforming and displaying spatial data. A GIS provides a framework for storing and combining different information layers which may be required to build a sampling frame, select the sample and compute expansion factors as well as information generated while conducting the survey. A wide range of GIS software tools exist and many packages are free of charge and most are open source while others are commercial. The most popular free GIS systems are GRASS and QGIS while the most widely used commercial GIS tool is Arc-GIS.

12.67 GNSS is based on a network of navigation satellites that is controlled by ground stations on earth which continuously transmit radio signals -captured by receivers- to determine the receiver's geolocation (longitude, latitude and elevation) on the earth. The GPS which is the oldest and most popular GNSS can provide support to field activities: geo-referencing plots, household or farm headquarters, locating sampling units or measuring areas of a plot.

12.68 In the Handbook on Master Sampling Frame, Remote Sensing refers to images acquired with a conventional camera or electronic sensors from aircraft or satellites. The techniques applied to process and interpret remote sensing imagery include visual photo-interpretation and a wide range of numeric algorithms.

12.69 Chapter 4 of the handbook on Master Sampling Frame provides guidance on the use and choice of technology to develop a sampling frame and later in the estimation process.

Suggested reading

- ◆ Handbook on Master Sampling Frame
- ◆ FAO/UNFPA, 2011.
- ◆ Cotter, J. and Nealon, J. (1987). Area Frame Design for Agricultural Surveys. National Agricultural Statistics Service, USDA, Washington.
- ◆ FAO (1995). Multiple Frame Agricultural Surveys-Agricultural Surveys based on Area and List Sampling Methods. FAO Statistical Development Series No. 7, Rome.
- ◆ Houseman, E.E. (1975). Area Frame Sampling in Agriculture. Statistical Reporting Service, SRS No. 20, USDA, Washington.
- ◆ UN (1982). Non-sampling errors in household surveys: Sources, assessment and control. NHSCP technical study.
- ◆ UN (1992). Handbook of population and housing censuses: Part I, Planning, organization and administration of population and housing censuses. Studies in methods, Ser.F, No.54.
- ◆ FAO(1998). Multiple frame agricultural surveys. Volume 2. Agricultural survey programme based on area frame or dual frame (area and list) sample designs. FAO Statistical Development Series 10, Rome

CHAPTER 13 USE OF SAMPLING IN THE CENSUS

13.1 As discussed in Chapter 8 many countries chose the option of sample enumeration, either exclusively, or in combination with complete enumeration. One of the main reasons behind such a choice is resource constraints. The agricultural census may also involve the use of sampling methods at other stages of census implementation, including census preparation and post-census activities. The section discusses sample design, which is one of key elements of the overall census design when sample enumeration is applied. The advantages and disadvantages of complete and sample enumerations as well as the factors to consider when choosing between these types of enumeration are also discussed (see paragraphs 13.67 -13. 80).

Uses of sampling techniques in an agricultural census

13.2 The most important applications of sampling techniques for an agricultural census are discussed below:

Use of sampling for census enumeration:

- ◆ In a census conducted following the classical approach (see Chapter 9), sampling may be applied when using the short-long questionnaire concept or conducting a sample-based census as a single one-off operation. In the former case the short questionnaire is administered to all target population of agricultural holdings, while the long questionnaire (with more detailed information) is administered only to a sample of such holdings (for more details see paragraphs 9.27-9.35). In a sample-based census under the classical approach, a large sample of holdings is selected for census enumeration conducted in one operation (see paragraphs 9.20 -9.25).
- ◆ In the modular approach (see Chapter 10), the core module is undertaken by complete enumeration whilst supplementary module(s) is (are) conducted by sample enumeration. Therefore, sampling is needed for selection of holdings to apply the supplementary module(s).
- ◆ When the census is part of an integrated census/survey system (see Chapter 10), sampling is paramount, as such a system comprises a light census based on a complete enumeration and the core module with rotating modules conducted on a sample basis.
- ◆ Sampling is equally applicable in the case of a combined census, since this is a combination of the use of administrative sources with the data collected based on the census enumeration, which could be conducted using sampling, according to the three above-mentioned census modalities (for more details see Chapter 11).

Uses of sampling at other census stages:

- ◆ During the preparation phase, in pilot censuses sampling methods may be applied to test census instruments and procedures (see Chapter 17).
- ◆ For quality checks during field operations when the work of enumerators and supervisors is evaluated using sampling techniques to avoid selections biases (see Chapter 17).
- ◆ To improve the census coverage, sampling can be used to enumerate the holdings beyond the master frame. Resource limitations may require that sampling for non-response follow-up be done⁷⁴.
- ◆ In post - enumeration surveys (PES) sampling methods are applied to assess the census coverage and the accuracy of responses (see Chapter 22).
- ◆ Sampling techniques can also be used for the preparation of flash census preliminary results to be disseminated shortly after census data collection (see Chapter 23).

⁷⁴ This is applied, for example, by Statistics Canada. See more details at: [Link](#)

- ◆ Of course, the uses of sampling for census activities mentioned in the cases e) – h) above are relevant for any of the four modalities for conducting the census.

13.3 All modalities of census taking may apply the combination of sample enumeration with complete enumeration. In addition to the above, there are other ways of combining sample and complete enumeration, such as:

- ◆ Use of complete enumeration of agricultural holdings with the largest contribution to agricultural production (e.g. in the most important agricultural regions of the country or/and above a certain threshold), which may constitute the bulk of the holdings in some countries. The rest of the holdings (e.g. those located in regions where agriculture is less important, or below the established threshold) are enumerated on a sample basis (maybe with a smaller questionnaire) to ensure a complete coverage of agriculture. This is applicable especially when carrying out a classical census but could also be applied in any modality. Censuses of this type were conducted in countries such as: Moldova, Russia, etc.
- ◆ Use of complete enumeration for some types of holdings (e.g. large and other “special” holdings (see paragraph 13.17), which may account for a significant contribution to agricultural production) while the remaining holdings (such as small and medium sized holdings, which constitute the bulk of census units), are covered by sample enumeration. In fact such a census may be considered as a sample enumeration census with one complete enumeration stratum. This is applicable to any census modality. This type of combination of sampling and complete enumeration was applied during 2010 census round in countries such as: Croatia, Mozambique, Seychelles, Tanzania, Uganda, Uruguay, etc.

13.4 In a census conducted using sample enumeration, the units to be enumerated (i.e. agricultural holdings) must be selected using strict statistical procedures. A probability sample is drawn from the frame population by using a specific sample design. A variety of sampling techniques can be considered for the construction of probability sample designs for agricultural censuses and surveys, including: simple random sampling (SRS), systematic sampling (SYS), stratified sampling (STR), sampling with probability proportional to size (PPS), multivariate probability proportional to size (MPPS), cluster sampling, multi-stage sampling, etc. Advances in sampling theory, such as calibration, ratio and regression estimation may also be used to improve the reliability of census data collected by sample enumeration. A detailed description of these techniques is outside the scope of this publication (the reader could refer to relevant publications suggested at the end of this chapter). However, some features of their use for censuses conducted by sample enumeration are presented below.

13.5 For one-stage (element) sampling (using such techniques as SRS, SYS, PPS or STR) to be cost- efficient two key things are needed: first, a fairly complete and up-to-date frame (listing of the elements) of the target population. Second, locating the elements and collecting the data must be feasible and economical. Besides, such techniques as PPS and STR have strong requirements for prior auxiliary information for each element in the population. Therefore, element sampling is not always feasible when conducting agricultural censuses, especially in countries with a not well established system of agricultural surveys. For a given sample size, it can be shown that sampling errors will be smaller in a single-stage sample design than if clustering is applied. However, the former involves a larger frame development and data collection costs because the sample in that case is more widely distributed than, for example, if two- stage sample design is used⁷⁵.

⁷⁵Global Strategy (2015): *Handbook on Master Sampling Frames for Agricultural Statistics*, p.39

13.6 Typically, the sampling design for an agricultural census consists of a combination of various sample selection techniques. A manageable sampling design often involves clustering and several stages of sampling.

13.7 In cluster sampling, a sample of clusters is first drawn from the population of clusters. In the next stage, all elements of the sampled clusters are taken if one-stage cluster sampling is applied, or a sample of elements is drawn from each sample cluster in the case of two-stage cluster sampling. The practical aspects of sampling and data collection are the main motivation for its use. An important advantage in cluster sampling is that a sampling frame at the element level is not needed for the whole population, but cluster-level frames are often accessible, for example when they are defined administratively or geographically, e.g. for districts, villages, enumeration areas (EAs), etc. Cluster sampling is especially motivated by cost efficiency, that is, the relatively low cost per sample element, because a lower costs of both listing and data collection (locating). However, in practice, clusters tend to be internally homogeneous, and this intra-cluster homogeneity increases standard errors and thus decreases statistical efficiency⁷⁶. Therefore, when constructing a sample design for agricultural censuses and surveys, more clusters will need to be selected and then subsampled using measures of size⁷⁷.

13.8 The multi-stage sampling procedure, which involves multiple sampling at different stages, aimed at achieving maximal accuracy of statistics for allowed costs, is largely employed for agricultural censuses and surveys.

13.9 The general overview of main types of sample designs applied in agricultural censuses is presented below. Census offices should choose the sampling design most appropriate for the country in each particular case, taking into account the resources available (including information, financial and human resources), the required accuracy of estimates of the principal characteristics, the desired level of aggregation for census data, etc.

Main types of sample designs for census enumeration

13.10 In an agricultural census which uses sampling methods a probability sample is drawn from the frame population by using a specific sample design.

13.11 As discussed in Chapter 12, a census frame should cover all statistical units of the population of interest (i.e. agricultural holdings) of the country without omission and duplication. A good sampling frame is supposed to provide full coverage of the population elements (sampling units), allowing the identification and the accessibility to each one of them.

13.12 Sample designs can be classified according to the type of sampling frame used, i.e. based on:

- ◆ list frames;
- ◆ area frames and
- ◆ multiple frames.

13.13 The main difference between these types of sample designs is whether the final stage of sample selection is a listing of holdings or households, or is land based, or if a combination of a sample of area elements with a list sample is applied to obtain the census estimates. The details regarding list frames are provided in Chapter 12 of this publication.

⁷⁶Eurostat (2008): *Survey sampling reference guidelines. Introduction to sample design and estimation techniques: Methodologies and Working papers.*

⁷⁷Global Strategy (2015): *Handbook on Master Sampling Frames for Agricultural Statistics*, p.65

13.14 The reader can find detailed explanations of each type of frames and related sample designs in the publication *Handbook on Master Sampling Frames for Agricultural Statistics (Global Strategy, 2015)* [[Link to Handbook on MSF](#)], as well as regarding sampling techniques in *Sampling methods for agricultural surveys* (FAO, 1989) [[Link to SDS 3](#)] and in other reference publications, some of which are specified in the section below. A brief summary follows.

Sample designs based on list frames

13.15 Sample designs based on list frames (or “list sample designs”) are the most commonly used sampling procedures in agricultural censuses. In this case, the sampling frame is generally a list of agricultural holdings or households (e.g. when a wider census is conducted (for details see FAO (2015), paragraphs 5.46-5.49)), which represent the ultimate sampling units. Both one-stage and multi-stage list sample designs can be applied when conducting a census. In the former case the units of interest for the census are selected directly from a list frame. In the latter case, the frame for the first stage of sampling is a complete listing of administrative units or geographical areas as primary sampling units (PSUs). The sampling frame used at the final stage is the list of holdings or households, developed within the selected clusters in one or more stages of sampling. Despite the fact, that PSUs (in some cases SSUs as well) applied in such a sampling procedure are area units, this type of sample design, for the purpose of this publication, also refers to a list sample design, because the ultimate sampling units (i.e. holdings or households), are selected from a list sampling frame.

13.16 A sampling frame should include relevant auxiliary information such as measures of farm size, e.g.: total area of the holding, area by main land use types, number of land parcels, number of household members, number of livestock of the main types. This auxiliary information is very useful in the construction of an efficient sampling design (facilitating STR, PPS techniques, etc.) and further, at the estimation stage. Pros and cons of this type of sampling frames are analysed in the *Global Strategy (2015): Handbook on Master Sampling Frames for Agricultural Statistics*. ([Link to Handbook on Master Sampling Frames for Agricultural Statistics, Chapter 5](#))

13.17 List sample designs often include some strata of “special holdings” that are completely enumerated, or have a high sampling fraction. Such strata consist of holdings that either correspond to a significant proportion of the total estimated value of important census characteristics, or whose characteristics may distort the results when selected in the sample. The strata of “special holdings” may consist of large commercial holdings, holdings with the largest area of agricultural land or for a given crop, those with the largest number of livestock, highly specialized holdings or those corresponding to a localized production, etc. Such list can be easily updated because usually those holdings are well known, visible and provide statistical returns. Often, commercial holdings, which form an important part of special holdings in many countries, are included in the business or farm registers.

13.18 All sampling techniques specified in paragraph [13.4](#), using one or more stages can be applied in list sample designs for agricultural censuses. The use of one-stage (element) sampling, cluster sampling and multi-stage sampling, as well as the peculiarities of sample designs applied in different census modalities are discussed below.

Use of one-stage(element) sampling

13.19 In one-stage sampling the units of interest for the census (holdings to be enumerated or households to be screened for holdings) are selected directly from a list frame. Element sampling is appropriate when an exhaustive up-to date list frame of agricultural holdings exists. This is usually the case of the countries with developed statistical systems and with well-established statistical farm register, or of countries which made special efforts to create such lists, e.g. in the framework of the pre-listing phase or by enumerating all holdings during the first

phase of the census. Of course, there is an additional request for relevant auxiliary information to apply STR or PPS techniques for selection of ultimate sampling units.

13.20 Along with the availability of an adequate sampling frame, the use of remote data collection methods, such as mailing, on-line, CAPI, CATI (rather than by personal enumeration), facilitates the construction of statistically efficient sample designs, including the element sampling. With the development of remote methods used for census data collection, element sampling procedure becomes more feasible.

Use of clustering in single-stage and multi-stage sampling

13.21 Cluster sampling is commonly used to account for geographic contiguity in the first stages of the sampling method. In this case, the population is partitioned into clusters or primary sampling units (PSUs), which are land areas, defined either administratively or geographically using natural boundaries or geo-referenced boundaries. PSUs could be districts, villages, other administrative units, or enumeration areas defined in the framework of agricultural or population census activities, etc. In single-stage cluster sampling a probability sample of PSUs is selected and every element in the selected clusters is surveyed. Using a cluster method, a sample of holdings can be selected indirectly by first selecting a sample of PSUs, which could be done using different sampling methods. One of the popular sampling techniques to select PSUs (when the list of agricultural holdings is not available) is the PPS method, with probability proportional to PSUs number of agricultural holdings or households since the latter information is usually available in most countries and approximates to the number of holders. Hopefully some additional information about the PSUs agricultural holdings will also be available for at least rudimentary stratification. The total population of each selected PSU would then be screened for agricultural holdings and a sample of holdings could be selected in a second stage of sampling.

13.22 Sampling by stages in a multiple stage list sample designs allows for greater flexibility to enhance the efficiency of the sampling design. Multi-stage sampling is widely used especially for the household sector. Its main advantage is that it is cost-effective and allows creating lists of holdings just in the selected areas, rather than for the whole country. In the multi-stage designs holdings or households are selected at the last stage of the sample selection process after first selecting PSUs, then selecting secondary sampling units (SSUs) from the selected PSUs, and so on. Usually, holdings or households are SSUs (in a two-stage sample design) but they may be also tertiary order units (in a three-stage sample design), which can be selected using equal probability sampling (either SRS or SYS) or PPS technique.

13.23 In a multi-stage sampling design the identification of the clusters that will constitute the primary stage (or sampling) units is paramount for the cost-efficiency of the design. Theory establishes that PSUs should be internally as heterogeneous, with respect to the variables of interest, as possible in order to catch the variability of the whole population with relatively small sample sizes of PSUs. In this respect, a prior stratification of PSUs is needed in order to build groups of PSUs as similar as possible. Guidelines for choosing PSUs in a multiple-stage sampling design are provided in the publication *Handbook on Master Sampling Frames for Agricultural Statistics* (Global Strategy, 2015) (Chapter 5). [\(Link to Handbook on Master Sampling Frames for Agricultural Statistics\)](#)

13.24 An overview regarding list sample designs which may be applied for different census modalities, based on country experience, is presented below.

Sample designs for classical censuses

13.25 In the sample-based censuses conducted under classical approach, element sampling (using such techniques as SRS, SYS, STR, PPS) can be applied to select the sample of the holdings to be enumerated. The selection of sample technique will strongly depend on the reliability of the sampling frame and the variables it contains. The use of STR and PPS will require relevant

auxiliary information, which could be provided, for instance, by a well-established, regularly updated statistical farm register or through a census listing operation.

13.26 Single-stage cluster and multi-stage sampling can also be applied in a classical census, e.g. when conducted using complete enumeration in the most important agricultural regions of the country and a sample of villages or EAs for the rest of the country (where agriculture is less important). It must be noted that, in contrast to the modular approach, the sample enumeration here is used on a different population (holdings not covered by the complete enumeration).

Box 13.1 Country example: One-stage sample design based on stratified sampling - Croatia, agricultural census 2010

The agricultural census was conducted in one operation, based on a large sample. The agricultural enterprises were covered by complete enumeration, while family farms were enumerated by sampling. In the latter case, based on the Statistical Register of Agricultural Holdings, a sample of 23,000 family farms was selected (out of 233 thousand units) using stratified sampling techniques.

The population of family farms was divided into two sub-populations, where different selection procedures were applied. The first sub-population consisted of family farms with calculated economic size expressed in European Size Units (ESU)¹. The stratification criteria used for sample selection of these farms were:

- ◆ Size variables with a combination of ESU and utilised agricultural area (UAA) – 8 classes;
- ◆ Specialization of the farm – 9 types;
- ◆ Territorial units: NUTS 2¹ level of regions – 3 units.
- ◆ The biggest farms with large ESU and UAA (9, 806 farms) were included exhaustively in the sample. The second sub-population included farms without defined ESU. These holdings were stratified according to:
 - ◆ UAA;
 - ◆ Area under orchards;
 - ◆ Area under vineyard;
 - ◆ Territorial units (NUTS 2 level of regions).

Systematic random sampling was applied for the selection of farms within strata.

Box 13.2 Country example: Combination of complete enumeration with cluster sample design - Suriname, agricultural census 2007/2008

The census of agriculture in Suriname was carried out on a complete enumeration basis in the Coastal Area, where the vast majority of agricultural holdings is located¹ and using sampling in the rest of the country, i.e.:

- ◆ In the Greater Paramaribo Area (District Paramaribo) because of the low intensity of agricultural activities and
- ◆ In the Interior (Districts Sipaliwini and Brokopondo and partially Marowijne), because of considerations of the wide geographical spread of small size holdings and difficulties to reach all of them.

For the rural area of the capital Paramaribo one-stage cluster sampling was applied with the selection of 10% of "Enumeration Blocks" (EB), defined based on *the population and housing census (PHC) 2004*.

For the Interior (rural inland of Suriname) a stratified sampling of villages was adopted. The total universe of villages was divided into three strata:

- ◆ Villages with more than 1000 inhabitants;
- ◆ Border villages with 1000 or less inhabitants;
- ◆ The rest of villages.

A complete enumeration was performed in strata 1 and 2. One-stage cluster sampling for census enumeration was applied in stratum 3, where 10% of EB were selected and canvassed.

Sample designs for modular censuses

13.27 In the modular approach, the list frame comes from the complete enumeration of the core module (see Chapter 10). When supplementary modules are carried out shortly after the core module, an in-depth on-desk analysis of the list produced by the core module enumeration allows the use of more elaborated sample designs. If supplementary modules are undertaken along with the core module, the use of CAPI devices can help with the selection of the sample for supplementary modules. The devices can be programmed to use information collected in the core module to draw real-time samples for the supplementary modules. However, this process poses some challenges and requirements which are discussed in Chapter 10.

13.28 In the modular census, a two-stage sampling design for supplementary modules is commonly applied, where EAs are the PSUs and holdings are the SSUs. This is a design that suits very well in-depth surveys covering an ample variety of situations when the application of detailed and time consuming questionnaires is needed. Depending on the availability of information about PSUs, SSUs, etc., the use of STR or selection with PPS would be appropriate to improve the efficiency of the sample design.

13.29 Supplementary modules in a modular census can be carried out using the combination of sample designs, e.g. one-stage design for some modules and two-stage for other modules. Some examples of sample designs applied by countries conducting modular censuses are presented below:

Box 13.3 Country examples: Sample design used in the agricultural census conducted under the modular approach

Togo, agricultural census 2011/2014: two-stage sample design for supplementary modules

At the first stage EAs (as PSUs) were selected with *the PPS (the number of households)*. At the second stage, a sample of *households* was selected with equal probability using SYS (with a rate of 6 holdings per PSU).

Burkina Faso, agricultural census 2006/2010: two-stage probability sample design for supplementary modules

At the first stage villages (as PSUs) were selected with *PPS*. The measure of size of villages was *the number of agricultural households*. For the second stage, a sample of agricultural households was selected with equal probability of selection.

India, agricultural census 2010 -11: combination of one-stage and two-stage sampling designs

For the census enumeration the states in the country were grouped into two categories: i) states with land records (covering 91% of the country area) and ii) states and Union Territories (UT) without land records, and Punjab state (which though a land record state, followed the procedure for data collection as in case of non-land records States).

The census was undertaken in three phases:

- ◆ **Phase-I:** complete enumeration of all agricultural holdings in land-record states and in all households of the sampled villages of non-record states, generating a short list of characteristics such as number and area according to gender, social group of holders, types of holdings, size of holdings;
- ◆ **Phase-II:** sample enumeration of holdings to collect detailed data on irrigation status, tenancy particulars, cropping pattern, terms of leasing, etc.;
- ◆ **Phase-III (Input Survey):** sample enumeration of holdings for collection of data on input use patterns of operational holdings in the country according to major data size groups and various crops.

In phase-I in non-land record states/UT and phase II in all states one-stage sampling schemes were used where 20% of villages in each Tehsil/Taluka (subdistricts in India) were selected.

In phase III enumeration in all States/UT was carried out using a two-stage sample design where in the first stage, villages were selected (7% of villages in each Tehsil/Taluka) and in the second stage, households were sampled in the selected villages.

More country examples regarding sample designs applied during WCA 2010 round are available at: [\[Link to country examples\]](#)

13.30 Sampling designs for the integrated census/survey system with AGRIS are similar to those under modular approach.

13.31 When the census is **combined with the use of administrative data sources**, the sample design will depend on the way of conducting field data collection.

Sample designs based on area frames

13.32 A sample design based on an area sampling frame (area sample design) is a probability sample method in which ultimate sampling units are land elements (areas). The main types of land elements in an area frame used for agricultural censuses and surveys are either areal units or pieces of land (often named segments) and points⁷⁸, i.e.:

- ◆ **Segments with natural (or physical) boundaries** (landscape elements such as roads, rivers or stable field boundaries)
They are usually sampled in two steps. In the first step the territory is divided into blocks that are larger than the targeted size for sample segments. These blocks are usually called Primary Sampling Units (PSUs)⁷⁹. PSUs can be stratified and sampled. The selected PSUs are divided into segments and one of them is sampled. The reader can refer for details to Chapter 6 of Global Strategy (2015). [\(Link to Handbook on Master Sampling Frames for Agricultural Statistics, Chapter 6\)](#)
- ◆ **Segments with a regular geometric shape, such as squares**
The sampling concepts are the same as the segments with physical boundaries.
- ◆ **Points**
In area sampling frames, points can be seen as small segments that contain a single land cover type, except in the case of mixed crops. Points can also be sampled inside enumeration areas or small administrative units (PSUs). The reader can refer for details to Global Strategy (2015) [\(Link to Handbook on Master Sampling Frame for Agriculture, Chapter 1 and 6\)](#)

13.33 The area frame is ideally suited for estimating parameters related to land areas, which can be also used to evaluate the quality of the data collection, e.g. to estimate the under coverage associated with the census.

13.34 In an area frame sample design for agricultural censuses the sampling unit should be associated to a holding. Since sampling units are land areas that may not coincide with the land of a holding, it is necessary to establish a criterion to associate each sampled land element with a holding so that a census characteristic value can be assigned to each segment as a function of its value in the associated holding. There are basically three methods of defining a reporting unit when the area sample design is used:

- ◆ **Closed Segment:** The reporting unit is a tract of land within the segment boundaries comprising all or part of a holding. Data are collected only for the land within the segment boundaries. In this case the farmer should provide information on the target variables referred only to the tract inside the segment. Therefore this method is not suitable for agricultural censuses.
- ◆ **Open Segment:** The reporting unit depends on the location of the headquarters of the holding or of the household. If it falls within a sampled segment, data are collected for the holding's entire operation whether or not it is included in the segment. No data are collected for holdings with land in the segment but whose headquarters is outside the segment.
- ◆ **Weighted Segment Estimator:** The reporting unit is all land operated by every holding that also has land within the sample segment. The estimator is based on the ratio of the holder's land in the segment to the land area in the entire operation.

⁷⁸ Another type of area frame elements, which is used commonly for environmental and forest surveys are *transects* (lines of a certain length) (Global Strategy (2015): *Handbook on Master Sampling Frames for Agricultural Statistics*, p.123)

⁷⁹ The concept of PSU in this type of area frames does not fully match with the usual concept of PSU in survey sampling textbooks that generally refer to large units inside which a sample of several SSUs is selected. It is a particular case where only one SSU is chosen in each sampled PSU and the traditional variance computation formulas for two-stage sampling do not apply (Global Strategy (2015): *Handbook on Master Sampling Frames for Agricultural Statistics*, p.118)

The details regarding the methods of defining reporting units in an area sample design are provided in Global Strategy (2015): [\(Link to Handbook on Master Sampling Frames for Agricultural Statistics, Chapter 6\)](#).

13.35 Most area sample designs for agricultural censuses consist of a stratified probability sample of land areas. The strata are defined by intensity of cultivated land, predominance of certain crops or other land-use characteristics.

13.36 The sampling process in an area sample design can involve single or multiple stages. The sampling techniques (i.e. STR, SYS, single or multi-stage sampling and multi-phase sampling), related tools, as well as the observation mode and the approaches to link sampling units with reporting units are discussed in the Global Strategy (2015), Chapters 1 and 6. [\(Link to Handbook on Master Sampling Frames for Agricultural Statistics, Chapter 1 and 6\)](#)

13.37 Area frame is well suited for estimating parameters related to land areas such as cropland (especially when direct observation is applied) and can be used to evaluate the quality of the data collection. However, the sample design based on area frame has major limitations for estimating other parameters required by a census (such as on livestock, demographic and social characteristics, etc.). A major problem of using solely an area sample design is that many important agricultural characteristics have a skewed distribution, concentrating a significant proportion of the total estimate in a small proportion of the holdings. As a consequence, the sampling of area units alone increases the sampling variance. When land of a large holding belongs to a sampled segment, the expansion factor can lead to inaccurate estimators for some variables. In an area frame design a large number of segments may even have no farms associated with them. For instance, farms that have livestock and do not have their own land are difficult to pick with an area frame.

13.38 Therefore, area sample designs for agricultural censuses are usually used in combination with list sampling frame. In that case the design is known as multiple frame sample design.

Sample designs based on multiple frames

13.39 For agricultural census and surveys purposes multiple frame sample design usually involves the joint use of area and list frames. Multiple frame estimates combine area sample with list sample estimates for each census characteristic. In this case, the results obtained from the list are added to the area sample estimates with no contribution to the overall variance.

13.40 A multiple frame sample design is most efficient when, a list of relatively few “special holdings” (see paragraph [13.17](#)) complement the larger population of smaller farms covered by the area frame. The special holdings should all be enumerated if possible. In some countries where a list frame design is applied to all known agricultural holdings (based on the available list of farms), the area sample design might be used to ensure full census coverage. The country examples of agricultural censuses conducted in Fiji and Puerto Rico representing both cases are described in Box 13.4 below.

13.41 The frames are usually not independent. Some of the frame units in one of the frames might be present in the other frame. The main concept underlying multiple frame estimators is that the overlap between two frames be identified. But this only needs to be done for the respective samples, not the entire frame. So, any duplication between the list frame (e.g. of special holdings) and holdings partially or totally included in the selected area sample segments must be eliminated from the selected segments. This operation of removing duplications of holdings requires special attention and resources. For this reason, it is important to utilize a manageable list of special holdings that would be feasible to inspect.

13.42 Multiple frame sample design can be used for any census modality where sample enumeration is applied.

Box 13.4 Country examples of sample designs based on multiple frames:

Fiji: *In the 2009 National Agricultural Census* the list frame was used for complete enumeration of large farms and farms with rare commodities (special farms) while area sampling frame was applied for the remaining farms.

The area sampling units, represented by segments with physical boundaries (of around one square kilometre in size), have been sampled in two steps. Enumeration Areas (EAs) defined by the Bureau of Statistics to conduct the 2007 Population and Housing Census were used for stratum identification, construction and selection of the segments. For stratification purposes the land area of Fiji was classified into nine land use strata. The EAs were first reviewed for the presence of pine forests and natural reserves. After these areas were removed, the remainder of EA was divided into one square kilometer grids (based on topographic maps) before the sampling process occurred. Sampling units were numbered (in a serpentine fashion) and a sample of segments using SYS was then drawn. After the segments were selected, the maps using recognizable boundaries “around the grid” were prepared.

Weighted Segment Estimator method has been applied for defining reporting units.

A 10% sampling of one square kilometer segments (100 ha) for a total of over 1,600 segments (10-12 villages per segment) were drawn from each of the crop production areas of land in each district. In total 9,338 farms were enumerated, including 461 large farms in the list frame. The total estimated number of farms was 65,000.

For further details the reader can refer to the national census Report: http://www.fao.org/fileadmin/templates/ess/ess_test_folder/World_Census_Agriculture/Country_info_2010/Reports/Manuals_4/FJI_ENG_MAN_2009.pdf

Puerto Rico (USA): *In the 2007 Census of Agriculture* the list frame (i.e. the mail list) was used for complete enumeration of all known farm operations. This mail list was supplemented by an area sample which accounted for farms not included in the mail list (NML).

For sampling, NASS stratified the Puerto Rico area frame on the basis of agricultural intensity, with strata consisting of: 1) land area with dense agriculture; 2) land area with sparse agriculture and few houses; 3) land area with sparse agriculture and many houses; 4) cities with no apparent agricultural activity; and 5) ostensibly non-agricultural land such as parks and military reservations. PSUs were created based on specific size requirements and permanent boundaries.

An additional sampling enhancement involved the grouping of *municipios* with similar agriculture into nine “clusters”. Within each stratum and cluster, a random sample of PSUs was selected and then further subdivided into target sampling units (segments). Of approximately 7,500 segments available for sampling, 300 were selected into sample. Aerial photography and maps for the 300 segments were provided to support field data collection. All NML farms (i.e. not found in the list frame), discovered within the 300 sampled segments, were included in the area sample.

For further details the reader can refer to the national census Report: http://www.fao.org/fileadmin/templates/ess/ess_test_folder/World_Census_Agriculture/Country_info_2010/Reports/Methodology_4/PTR_ENG-SPA_METb_2007.pdf

Sample designs applied at other census stages

13.43 In selecting the holdings for the pilot census, an one-stage cluster design can be applied, where administrative units or geographic areas such as villages, or enumeration areas are defined as sampling units and holdings inside the selected EAs are observation units. Such design is cost-effective and allows testing census materials and the performance of enumerators in different parts of the country and diverse conditions avoiding the potential bias of an on-purpose selection (see also Chapter 17).

13.44 The selection of holdings (questionnaires) for quality checks performed during field operations usually is done using SRS or SYS techniques. For more details see Chapter 17.

13.45 Post-enumeration Surveys (PES) are commonly conducted using one-stage cluster sampling to allow the estimation of coverage errors of the census. The explanation of sampling procedures in PES is presented in Chapter 22.

13.46 For a rapid preparation of some preliminary census results the selection of completed census questionnaires using systematic random sampling technique can be applied. For more details see Chapter 23.

Box 13.5 Country example: Hungary – use of sampling for production of preliminary census results.

Hungary uses sampling for rapid production and dissemination of preliminary census results starting with 2000 agricultural census. For these purposes 1 percent sample of the filled out census questionnaires, was selected using SRS technique (to be checked). After recording, processing and analysis of the data from the sampled questionnaires, preliminary estimations for key census items have been produced and published.

Country examples: Use of sampling techniques for PES (Italy, Venezuela) -Link

Choice of sample design

13.47 The statistical survey method on which to base an agricultural census or survey in a given country should carefully consider the local conditions, resources and requirements. Achieving maximal accuracy for available total budget, or minimal costs for required accuracy are two ways of stating the aims of efficiency, depending on which of the two (budget or accuracy) is fixed or less flexible.

13.48 The choice of sample design should be made taking into account the resources available, including the availability of trained personnel, financial and information resources, as well as the required accuracy of estimates of the principal characteristics and desired level of aggregation for census data.

13.49 The sample design should also be simple enough to operate in the field with the help of available personnel. Practical field instructions are essential tools for making the actual sample to approximate the sample design. For more details regarding the feasibility and practicability of sample designs the reader can refer to FAO (1989) (Section 9.6). [\[Link to SDS 3 \]](#)

13.50 The **total cost and requirements of personnel** (the number and the period), the construction or updating of the sampling frames and other required facilities should be clearly assessed and definite government approval obtained for covering the expenditure. In case funds and other resources required are beyond the capacity of the country, the sample design has to be adjusted keeping in view the resources actually available and the authorities/stakeholders have to be informed of the type of results that will be achieved with this change in the sample design.

13.51 Often resources committed originally are not always made available in full and at the time required. This could lead to failure of the sampling design unless this factor is kept in mind while planning the sample design. It is perhaps advisable to plan on the basis of resources which are most likely to obtain. Alternatively, a sampling plan which can easily be adjusted according to the actual resources available at the time of carrying out this phase of the statistical operation should be developed. This really requires a great deal of expertise on the part of the statistician, a periodic review of the resources and an intimate knowledge of how the census operations are proceeding (see also Chapter 4). Of course, once the original design has been carefully chosen, it should not be abandoned or modified except for serious reasons.

13.52 The appropriate **sample size**, which affects the precision, census costs and duration of data collection, depends upon many factors, such as the efficiency of the sampling design adopted, the desired level of aggregation for census data, including the requirements for national versus subnational estimates. In some cases the requirements regarding the accuracy and the production of statistics at different subnational levels are stipulated in the legal acts. If, for instance, the data are needed at a low administrative or geographical level (small area estimation), a much larger sample will be needed. As a rule of thumb, no attempt should be made to make sampling estimates for areas or groups of holdings for which less than 200 to 300 sample questionnaires have been completed. A critical examination of the sample size should be made based on the results and findings of the pilot census, especially regarding the variability of different characteristics, as well as the time and cost involved in obtaining information on them.

13.53 The availability of a complete and up-to-date sampling frame and of the relevant auxiliary information for sample design or the need for updating or developing the frame should be carefully considered when sample enumeration is planned and further, for constructing a sample design. When modular census is planned, the relevant frame items should be included in the core module to allow the selection of holdings to be enumerated in supplementary modules (see Chapter 10).

13.54 Cost comparisons are essential for the choice of types of sampling designs according to frames used. The choice of sampling frame needs to consider the cost of developing or updating a sampling frame and costs of data collection associated with the frame. The development costs for the list frame need to consider not only the establishment costs but also those associated with regular updates.

13.55 For an agricultural census to be conducted by sample enumeration the sample design should be chosen by considering the characteristics of multiple frame and list sample designs along with their comparative advantages, disadvantages and requirements. Comparisons of the different types of sample designs require special statistical knowledge that is beyond the scope of this publication. Nevertheless, a few simple indications will be given in the following paragraphs to illustrate the factors to be considered when choosing an appropriate sample design for an agricultural census.

List sample designs versus area sample designs

13.56 Both types of sample designs have strengths and weaknesses. Lists of farms with associated auxiliary data on size measures is more statistically efficient for census sample design purposes, providing often better estimates for important census characteristics (especially for

those non-related to land area and crops), than an area frame. However, in many cases the list frames are not complete or up-dated. The main advantage of an area frame design compared to a list frame design is that completeness of the frame and non-overlapping units are easy to ensure and extrapolation factors are reliable and not difficult to compute⁸⁰. Area frames, while complete, are more suited for measuring small farms and for estimating parameters related to land area and crops widely distributed (see paragraph 13.37). On the other hand, sample sizes must be large enough to control sampling variability if there are large farms (and other “special holdings”).

Multiple frame designs versus area sample designs:

13.57 Multiple frame designs that combine an area sample with (at least) the list of special holdings to be completely enumerated during field data collection are preferable to area sample designs since they can provide more accurate estimates of important census items (characteristics) and because the extra work involved in design and implementation will generally not be significant.

Multiple frame sample designs versus list sample designs:

13.58 Some pros and cons of multiple frame sample designs in comparison with list sample designs are discussed below. When referring to an area sample it will be assumed to be the area sample component of a multiple frame design that also includes a list frame of special holdings.

13.59 For an agricultural census to be carried out by sample enumeration or for surveys conducted in the integrated census/survey modality the following preliminary considerations can be used to compare the different types of sampling frame and sample designs:

Precision of the estimates. The area sampling frame component of the multiple frame is well protected against under coverage, especially of farms that operate land. Therefore, the multiple frame design obtains more precise estimates of agricultural areas, than a pure list sample. However, area sample design has limitations for estimating other parameters required by a census (such as on livestock, demographic and social characteristics, etc.).

Basis for a crop yield estimation. An area sample provides the means to better estimate crop yield by direct observation as part of census enumeration. This is relevant, for instance for countries which take the opportunity of census data collection to fill in the information gap on agricultural production of small farms.

Complexity of implementation. The implementation of an area sample design requires more technical expertise than the implementation of a list sample design. Moreover, multiple frame design involves “all the complexities of single frame surveys, as well as the additional requirement that the overlap between frames be determined” (FAO (2015), p.94).

Mapping requirements. The selection of an area sample requires accurate mapping on which to identify and measure areas. It requires the availability of suitable topographic charts, and preferably satellite images, as well as scale-transfer and area measurement instruments. Appropriate graphic materials such as ortho-rectified aerial photographs or high-resolution satellite images of the selected segments are a great advantage if objective measurement of areas is required.

Proximity of the holder or respondent to the holding. It may not be feasible or even possible to use area sample in some countries due to difficult terrain or due to certain social mores of the rural population. Area sample methods should not be used if, for

⁸⁰ Global Strategy (2015): *Handbook on Master Sampling Frames for Agricultural Statistics*, p.132

instance, the information obtained from holders who do not live close to their holdings or who are difficult to locate corresponds to a large percentage of the total value of important survey variables.

Distinguishing characteristics. A distinguishing characteristic of multiple frame sample designs is that they have benefited from important technological advances in digital processing to a larger extent than list sample methods. In fact, area sample methods can utilize satellite images, spatial data or even digital satellite data as part of GIS, hand-held GPS and other Global Navigation Satellite Systems (such as GLONNAS, GALILEO, BDS)⁸¹ and Remote Sensing as well as a variety of software tools, automated procedures and techniques for sample selection and data analysis.

For further details on the subject, the reader can refer to the publication: FAO (2015) [\(Link to Global Strategy \(2015\). Handbook on Master Sampling Frame for Agriculture, Chapter 6\).](#)

Complete enumeration censuses versus censuses carried out on a sample basis

13.67 As mentioned in Vol. 1 (Chapter 4, paragraph 4.34), when deciding whether to conduct a census by complete or sample enumeration, in addition to efficiency considerations (precision versus costs), other elements should be taken into account, such as: desired level of aggregation for census data; use of the census as a frame for ongoing sampling surveys; data content of the census; and capacity to deal with sampling methods and subsequent statistical analysis based on samples.

Main advantages of complete enumeration (over sample enumeration)

13.68 When complete enumeration is applied, census results can be produced for the smallest administrative and geographic units with no sampling errors, allowing various tabulations (including ad-hoc cross-tabulations) in line with high user requirements. (*In sampling the amount of subnational data and cross-tabulations that can be produced is limited.*)

13.69 Some crops (such as rare and emerging crops), although cultivated only to a limited extent and rare types of livestock may be of significant or growing economic importance. Information on such rare events can only be reliably obtained from a complete enumeration. (*Sampling cannot provide accurate information on events that occur infrequently.*)

13.70 The census based on complete enumeration provides a reliable frame for the organization of subsequent regular infra-annual and annual sample surveys. In terms of frames, it is much less demanding in respect of the holdings' characteristics (especially auxiliary information) than a sample-based census. (*A sample-based census may not ensure an adequate or complete frame for agricultural surveys; use of sampling requires a reliable sampling frame.*)

13.71 The planning and implementation of an agricultural census conducted on a complete enumeration basis requires fewer highly qualified statistical personnel with expert knowledge of sampling methods than a census conducted on a sample basis. This is particularly important in countries with limited technical expertise. (*Application of sampling requires personnel who are well trained in sampling methods and analysis.*)

⁸¹ Global Navigation Satellite Systems: Russian system GLONNAS, Chinese system BDS and the European Union system GALILEO: Global Strategy (2015), p.74

13.72 Aggregating data from a complete enumeration is straightforward and does not involve statistical estimations. *(Analyzing the data from a sample enumeration requires the use of more complicated techniques.)*

Main disadvantages of complete enumeration (over sample enumeration)

13.73 One of the biggest disadvantages of a census based on complete enumeration is its cost and administrative complexity. In a country with a large number of holdings, census conducted as a complete enumeration is, in practice, more expensive and time consuming than a census conducted on a sample basis. This is a particularly important consideration when some parts of the country with difficult access contribute in a low proportion to agricultural production. *(Sample enumeration is generally considerably less costly than a complete enumeration.)*

13.74 The high overall response burden when full count of holdings is applied is another disadvantage, especially in countries which experiences increasing difficulties in enumerating agricultural production units. *(Sample enumeration of a limited number of respondents contributes to decrease the overall response burden.)*

13.75 A complete enumeration census requires a very large number of enumerators and supervisors. Quite often candidates with the desired qualifications are not available in the required number so the standard might be lowered with a consequent effect on the quality of data. Along with this, adequate training of a large number of field census staff in a short period of time is also challenging. The shortage of trained and experienced field staff, including the lack of good quality field supervision, along with other difficulties related to the organisation of field data collection for a large number of holdings could lead to significant non-sampling errors in a census based on complete enumeration. *(A census conducted on a sample enumeration basis requires a smaller number of enumerators and supervisors than a census conducted by complete enumeration. Consequently, the quality of data collected on a sample basis can be expected to be much better because of the employment of better trained enumerators and supervisors and better quality control.)*

13.76 The amount of data to be processed is very large in a complete census. The results may be considerably delayed if not sufficient data processing capacities are in place. The cost of processing the data will be higher due to the large volume to be processed. *(Sample enumerations require less processing capacity (fewer questionnaires to process) and the results are usually available sooner.)*

Factors for consideration in choosing between complete or sample enumeration

13.77 Sample enumeration is an optimal alternative where there is severe limitation of funds and personnel, and the aim is confined to securing data with reasonable accuracy for major administrative units across the country.

13.78 A decision whether to carry out a complete or a sample enumeration of holdings will depend on the level at which the census data are required, that is whether the results will be tabulated for the entire country, for provinces, districts or even for smaller administrative units (such as communities).

13.79 Even the countries that lack resources should seriously consider the possibility of undertaking at least a part of the census items on a complete enumeration basis. This is to ensure a good base for preparing an efficient sampling design for the collection of detailed data on important items of the census, for planning future agricultural surveys to collect current agricultural statistics and to be able to produce at least some data for small administrative units.

These countries may adopt cost-effective modalities, such as the modular census or integrated census/survey programme.

13.80 Sample enumeration is less costly in terms of field work and allows decreasing the overall respondent burden in comparison with complete enumeration. However, it requires a reliable sampling frame, as well as the capacity to deal with sampling methods and subsequent statistical analysis based on samples.

Country examples regarding sample designs applied during WCA 2010 round are available at: - Link

References and suggested reading:

- Barnett, V. (2002). *Sample Survey: Principles and Methods*: John Wiley & Sons
- Biemer and Lyberg (2003). *Introduction to Survey Quality*
- Cochran, W. G. (1977). *Sampling Techniques*, 3rd edition. New York: John Wiley & Sons.
- FAO(1989). *Sampling methods for agricultural surveys*. Statistical Development Series No 3
- FAO (1989). *Sampling Methods for Agricultural Surveys*
- FAO (1998): *Multiple Frame Agricultural Surveys*. Statistical Development Series No. 10, Volume 2.
- Global Strategy (2015). *Handbook on Master Sampling Frames for Agricultural Statistics*
- Global Strategy (2014). *Technical Report on the Integrated Survey Framework*
- Global Strategy (2014). *Technical Report on Linking Area and List Frames in Agricultural Surveys*
- Hansen, M.H., Hurvitz, W.N. & Madow W.G. (1953). *Sample survey methods and theory*. New York: John Wiley & Sons.
- Kish L. (1965). *Survey sampling*. New York: John Wiley & Sons.
- Lehtonen R. & Pahkinen E. (2004). *Practical Methods for Design and Analysis of Complex Surveys*. 2nd ed. Chichester: John Wiley & Sons.
- Kott and Vogel 1995
- Lohr, S. (2009): *Sampling: Design and Analysis*, 2d edition. Duxbrury press
- Steiner, M., Bailey, J., Beranek, J., Parsons, J. *Improvement of Sample Design by Using Results from the Agricultural Census:*
http://www.fao.org/fileadmin/templates/ess/documents/meetings_and_workshops/regional_workshop_sampling_2010/China_MPPS_Sampling_Paper.pdf
- McNabb, D. (2014). *Nonsampling error in social surveys*
- Vogel, F.A. (1986). *Sample Design and Estimation for Agricultural Sample Surveys*. Statistical Reporting Service, NASS/USDA, Washington.

CHAPTER 14 QUESTIONNAIRES AND INSTRUCTION MANUALS

Questionnaires

Development of the census questionnaire

14.1 Data needs are used to determine the census scope and coverage. When the scope, coverage and methodological approach of the census have been determined, a census questionnaire(s) can then be designed. The questionnaire(s) is designed to collect relevant information in a systematic manner. The census questionnaire is the most basic document in the census programme since it becomes the vehicle for collecting the desired information. Any deficiencies in the questionnaire design will lead to incomplete and inaccurate data being collected. Considerable thought should be given to formulating the questionnaire and input sought from available experts on this subject matter.

14.2 Design and characteristics of the census questionnaires depends on :

- ◆ **the census modality** (classical approach, modular approach, register based census or integrated census and survey programme) (See Vol I Chapter 4);
- ◆ **the type of holding** (holdings in the household sector and holdings in the non-household sector);
- ◆ **the method of data collection:** paper-based questionnaires (for face-to face interviews or questionnaires to be mailed) or electronic questionnaires (to be used with CAPI or CASI) (see Chapter 18).

Questionnaires should also be different according to the purpose of the survey: intended for objective measurement or a community level survey. Nevertheless there are general characteristics of census questionnaires that apply to all methods of enumeration (see Volume 1, paragraph 4.38) or holding types.

General characteristics of census questionnaires

14.3 The size of the questionnaire is one of the first items to be considered. The questionnaire should not be too large. Its size should be such that the enumerator can easily record the respondents' answers in a reasonable time. In WCA 2020, (See Volume 1 paragraph 10.2) it is recommended that the tabulation plan be determined before designing the census questionnaires in order to ensure the data collected meet the requirements for the tabulation programme. This is an efficient way to include in the questionnaires all and only those items really important. The temptation to use the census to ask a great number of questions of interest to official and private data users should be resisted even if it is often argued that once the holder has been contacted, maximum advantage should be taken in collecting the necessary census information as it is more costly and time consuming to meet him/her than to obtain data through many other data collection methods such as mail or phone. However, this argument is not valid for many reasons. Frequently the data requested are not readily known to the holder who may need to consult the records and other members of the household, which takes time. Furthermore, if the questionnaire is lengthy, the holder, who at the outset is prepared to reply to the questions, may become less cooperative after being questioned for a long time. Also, experience shows that a large proportion of items are not processed, analyzed or used. It is, therefore, very important that the questionnaire is not too lengthy and focuses on the collection of data to be tabulated . However, it is difficult to establish the ideal length of a questionnaire because this depends not only on the number of questions it contains, but also on their degree of complexity which reflects

directly on the length of time the holder needs to answer. Not only is the holder affected adversely by the length of the questionnaire and duration of the interview, but the enumerator also becomes tired and makes careless mistakes in recording the data. As a general rule, an interview should not exceed 45 minutes.

14.4 The definitions and concepts to be used in the questionnaire should be carefully studied and care should be taken to make sure that they are easily understood by the holder and the census field staff. These should also be harmonized with those used in the other Agricultural Statistics programme for the purpose of enhancing the efficiency of data integration across programs as well as facilitate coherence and multi-industry/sector analysis. Where needed, the questionnaires should be in languages understood by the holder. An endeavour should be made to use definitions and concepts that follow the recommendations of FAO and other international organizations, for purposes of data comparison at regional and global levels.

14.5 In the classical approach (and most probably in registers-based censuses), census data collection should be limited to structural items (see definition Vol.1, paragraph 1.1) which do not change quickly over time, while more detailed information should be collected through specialized surveys subsequent to the census enumeration. However, when using the modular approach or the integrated census/survey modality, some type of non-structural information could be taken in the supplementary modules or rotating modules, respectively.

14.6 It is observed that if the questionnaire is too lengthy, after carefully studying the subjects to be included and the corresponding questions, various possibilities may be considered to optimize the questionnaire design

14.7 One possibility is to distribute the questions in two or more questionnaires. When using electronic questionnaires and CAPI, filters may be included so that only relevant questions are asked to the holder. Small holdings in the household sector use less inputs like machinery or hired workers than larger holdings or holdings in the non-household sector. Then, those items could be included in another questionnaire (to be applied to large holdings and holdings in the non-household sector). In this case the first questionnaire would be of an acceptable length and the second would be rather small. This procedure is used also to collect an extensive set of data: the first questionnaire applying to all the holdings and the others relating to only specialized items like vineyards, greenhouses, nurseries, etc., in the modular approach or in the classical approach when the census is sample-based. . In addition, when designing sample-based census modules to target specific populations and collect a wider set of data, the reliability of the results of the sample has to be taken into account when deciding what questions are going to be included in each questionnaire as explained in Chapter 10).

14.8 Another possibility is to use different questionnaires for different provinces when these differ considerably in crop and livestock types and agricultural practices. In this case various items could be removed completely from the questionnaire of one province and its length reduced considerably maintaining the general characteristics. For example, if one province is known to be almost exclusively a livestock production area and owing to its physical characteristics has no permanent crops, the questions regarding crops may be reduced and those relating to livestock expanded.

14.9 Once the decision on what subjects and items are to be included in the questionnaire has been taken, attention must be paid to question sequence, that is to say, they should be set out in a logical order so that it is easy for the holder to supply the requested information. All the questions on one subject should be grouped together. The questionnaire is then divided in "sections". Typically, the "Themes" in Chapter 8 of Volume I would be the sections of the questionnaire, depending, of course, on the census scope and modality. For example, the questionnaire for the 2007 St Lucia Census of Agriculture was divided in:

Section A: Identification and Location of agricultural holding;
Section B: Identification and legal status of holder;
Section C: Population and Employment;
Section D: Land;
Section E: Permanent crops;
Section F: Temporary crops;
Section G: Livestock;
Section H: Machinery and Equipment;
Section I: Selected practices and facilities;
Section J: Other (farm organizations, gender, agricultural income, etc.)

14.10 The questions should be formulated in a clear simple language, using, wherever possible, the vocabulary familiar to the holder. This is not always possible because in the majority of countries there are local differences, and expressions which are very common in one part of the country may be unknown in another. However, when there are terms commonly used by the holder, although these may not be correct idiomatically, they should be employed in preference to others. Similarly, measurement units sometimes vary from province to province. It is desirable to record the data in local units and to convert into standard units later in the census office.

14.11 Special provision will have to be made whether two or more languages are used in the country. Different methods could be applied to deal with this situation when paper-based questionnaires are used, such as the use of: i) a single, multilingual questionnaire; ii) one version of the questionnaire for each major language; iii) translations of the questionnaire in different languages available in the enumerators' manual, on the Internet site for the agricultural census. When electronic questionnaires are used (under CAPI or CASI methods) the availability of census questionnaires in different languages can be easily solved.

14.12 At times it is advisable for a smooth transition between subject matters or to lead into a subject to use introductory questions or statements, which are not tabulated, but serve as a control or to introduce another question so as to retain the respondent attention. For example, the area rented from others could be asked directly, but it is preferable to ask first whether any land was rented from others and, if so, how many hectares were rented. The questions sequence is important to get better answer and anticipate the respondent mood and energy. The core question should be asked first and then the support question.

14.13 The validity of various questions in the questionnaire can be evaluated by conducting a pre-tabulation before designing the questionnaire (see paragraph 14.3). Through such tabulation it is possible to determine whether all information targeted from the census can be obtained. Each question appearing in the questionnaire could then be studied to determine whether it could supply the data needed in the tabulation plan (see Chapter 6). As a general guide, data not intended for tabulation should not be collected. There are some exceptions, such as: identification (name of the holder, address, etc.), introductory questions mentioned above and questions intended for data validation.

Characteristics of paper based census questionnaires

14.14 When the method of data collection is by means of face to face interviews based on paper questionnaires (Paper and Pen Interview) or by means of regular mail, there are some special characteristics of questionnaires that need to be considered.

14.15 Apart from the size, also the shape of the questionnaire should be such that the enumerator can easily handle it in the field while recording the respondents' answers.

14.16 Attention should be given to the quality of paper used. Thin paper should not be chosen because during the field work the questionnaire is often subjected to very unfavourable climatic conditions and to constant handling during the distribution of the document and the subsequent data entry and tabulation.

14.17 Another aspect to be considered is the color of the paper. When different types of questionnaires are used for collecting information, in the modular approach (the core module questionnaires to be answered by all holdings and the sample-based supplementary modules' questionnaires) it is convenient to print them in different colors so that they can be easily distinguished and errors avoided in handling the paper-based census questionnaires. Light colors which do not strain the eyes and on which it is easy to read should be chosen. Different colors also apply when an agricultural module is taken along with other censuses like the population census or the economic census.

14.18 The size of the print should be easily read even when light is not adequate. This occurs frequently when the holders are interviewed in the evening, since in many rural areas there is minimum lighting. It is not advisable to use small print in order to keep questionnaires to a reasonable size.

14.19 Efforts should be made to use a different type of print for the questions and for notes or instructions to the enumerators. The questions must be easily distinguished since most of them will have to be read aloud to the holder. However, very heavy print should not be used as the questionnaire will look overloaded.

14.20 The space for replies should be large enough so that there is room for responses to be entered and the lines should not be printed too close together. If lines are close the enumerator, when correcting some of the answers given by the holder, may rub out the preceding answer with the result that the question has to be repeated or the data is omitted or made illegible. The questionnaire must be uniform in style, that is to say the readings should all be printed with the same type of characters and fonts, the explanatory notes with another type or in brackets or shaded, and in a certain position with respect to the question, after or below it. Similarly the coding system, if any, should be printed in the same position and be of the same size in each section of the questionnaire. Enough space should be left between the questions so that they are distinct and can be easily located. The images can help provide the same mental picture of a crop or livestock. The same livestock or crop may have different name in different part of a country.

14.21 Each question should be numbered so as to be able to refer to it easily in the instructions and elsewhere. The same applies when the answers are recorded in different columns; each column must bear a number or letter. Question numbering is important for generic variables name in the data processing.

14.22 Paper based questionnaires should be as much pre-coded as possible to diminish the editing and coding process and also to avoid errors in writing answers.

Characteristics of electronic census questionnaires

14.23 Either in face to face interviews when using Computer Assisted Personal Interview or on-line inquiries, electronic designed questionnaires are needed. Unlike the paper form, electronic questionnaires allow drop-down menu for answering, pre-programmed automatic jumps in the questions, consistency checking during the interview and the possibility of handling several linked questionnaires in the same interview. Drop-down lists, real-time edits and automatic jumps performed during enumeration will ensure a faster and more reliable

interview. The technology allows direct data transmission to field and central offices. This eliminates the costs associated with printing and distributing paper-based questionnaires and time of scanning or keying data and allows supervisors to immediately address problems while data are being collected. Finally, the data results are faster.

Country examples (Cote d'Ivoire, Mexico)- Links.

14.24 When utilizing internet portals or handheld devices such as smart phones, tablets, etc for conducting the census, sufficient time must be given to test and implement bug-free electronic questionnaires and related software systems. Performance of the devices, programs and systems should be tested by simulating volume testing with multiple concurrent users. Clear and precise expectations in terms of performance and volume should be established very early in the development phase. Last minutes changes in the questionnaire may affect the overall quality of the programmes and in turn, the census quality.

14.25 When programming an electronic census questionnaire, the temptation of putting many consistencies checking during the filling of the form should be avoided because it can greatly extend the time of the interview boring the respondent and jeopardizing the whole quality of the responses. Data entry applications should limit checking to problems that are either very serious (for example, wrong EA code), or caused by a simple misread or key entry mistake. Blocking checks should be avoided but warning errors need to be allowed.

For example, the total area of the holding should be equal to:

- a) the sum of the areas under the 9 different land uses (Vol. I paragraph 8.2.13),
- b) the sum of areas under different land tenure types (Vol. I paragraph 8.2.45), and
- c) the sum of the areas of all the parcels.

Usually it is difficult that during the interview areas reported for a), b) and c) equal the holding area. This is a typical checking that should not block the interview unless great differences are observed (the magnitude of the differences should be decided when programming the device). More sophisticated checking should be deferred until the editing stage.

14.26 An adequate balance between the time it takes to record each answer and their consistency is crucial for ensuring the quality of the recorded information.

14.27 Another important advantage of electronic questionnaires is that it is very easy to switch between different languages or dialects. In countries where distinct languages or dialects are used, electronic questionnaires avoid the problem of translating the questions expressed in only one language (like in paper-based questionnaires) to the informant. The translation made by the enumerator not always reflects the concepts behind the question. Therefore, the possibility of reading the questions directly in the informant's language improves the quality of the census data.

14.28 The handheld device used for census taking should present the questionnaires clearly under any light condition also under the sun light to allow conducting the interview under different weather situations.

14.29 When programming an electronic census questionnaire, it is important to allow quick links to maps, satellite imagery and GPS to help enumerators in the field work.

Community survey questionnaires

14.30 The collection of community-level data within the census of agriculture is advocated in the WCA 2020 Programme. The statistical unit is not the holding but the community and data collected refer to it. The persons interviewed are no longer agricultural holders but community referents like community administrators, local authorities or local leaders. The list of items to be

collected do not refer to agricultural activities at holding level but to key administrative information (for a list of recommended items for community surveys see Volume 1, paragraph 9.21). Therefore specific questionnaires need to be designed.

14.31 The previous considerations about census questionnaires both paper-based and electronic apply here. In this case the community survey questionnaires would be shorter than a classical census questionnaire but sometimes longer than the questionnaire for the core module in the modular approach because usually they will comprise fewer questions and they must guarantee adequate links with the holdings in the community area.

14.32 The questionnaire should also take into account that part of the information in a community survey can come from administrative registers. The survey should not be used for collecting data already available from reliable administrative and/or statistical data sources.

14.33 A typical community survey questionnaire could be divided in the following sections:

- ◆ Geography
- ◆ Socio-economic conditions Community infrastructure
 - Availability of agricultural services
 - Availability of other services
- ◆ Development programmes

A list of possible items for inclusion in different sections are provided in Volume 1, Chapter 9.

Country examples (Haiti, Nicaragua, Malawi, Myanmar, Lao PDR)- Links.

Census questionnaires working group and user-producers consultations

14.34 At early stages of census preparation it is advisable to organize a users-producers workshop. It means to put together the producers of information and main users of it in order to discuss all census stages and to guarantee the ownership of the census project to main users (Chapter 6). Such workshop should be a good opportunity to discuss the census content along with the census methodology. A sub-group of users from the workshop can be integrated into the census questionnaire working group participating in the subsequent discussions and decisions.

14.35 Bearing in mind that the information obtained in the census will be used by country's agricultural planners, researchers, projects developers etc it is very important that a working group be formed whose task will be to work with data users to determine the specific questions which the census questionnaire should contain. The group should include staff who is involved in agricultural planning, in collection of statistics or as a data user within the agricultural sector (business associations, etc). These staff know the informational needs and can visualize how the data obtained will be used. They should hold responsible posts in their respective departments. It is not advisable for the group to be too large. A basic group of senior and experienced officials could be formed. The group can be assisted by specialists from the different ministries according to the subjects to be discussed. For example, when aspects of irrigation and drainage are considered, experts from the ministry in charge of the country's water and irrigation resources should be present. A data processing specialist should also be associated with the formulation of the questionnaire.

14.36 Reference should be made to the last agricultural census taken in the country, if available. Additionally, similar census questionnaires (for example, questionnaires of other countries in the same region [refer also to FAO website]) and other national reports where issues were identified and recommendations were made, can also be considered. When the previous census questionnaires and/or questionnaires of other similar censuses are used as a starting point, each of the items should be carefully examined. The content of the questionnaire

should be compared with international recommendations and each of the questions examined, studying the difficulties encountered and the use to be made of the information collected.

14.37 As the economic planning in a country becomes more refined as agriculture changes, the information needs change and items which were not included in the census conducted earlier may now be important. The reverse may also occur, that is to say that subjects considered useful in the previous census are no longer of any value. However an analysis is needed because the census should be suitable for trend analysis and it is important to see if the questionnaire is able to maintain time series. These facts are taken into consideration in the successive FAO Census Programmes. For a list of items to include in the census questionnaire see Volume I, Chapters 7 and 8.

14.38 It is advisable to study the questionnaires used by other countries, especially those of the same region, because it is quite possible that their information needs will be similar and they may have similar data collection problems. It may be possible to profit from their experiences, utilizing ideas and approaches not only as regards to the items included, but also the presentation, taking care, of course, to examine whether these specifications are applicable to the country.

Questionnaire design and data processing requirements

14.39 The raw data taken during the census (conducted under any modality) need to be processed in order to obtain the final tables and other reports. The first stage of processing is data entry. There are three main methods for data entry, the first two applicable to paper-based questionnaires and the third one to the use of CAPI or CASI:

- ◆ keypunching or “manual data entry”;
- ◆ scanning;
- ◆ automatic data capture from the electronic questionnaire.

14.40 The way the data are going to be entered is very important when preparing the census questionnaire. However, some general rules apply to all types of questionnaires. In the following sections, guidelines for processing of census questionnaires in general and specific to the different data-entry modalities are presented. For definitions and characteristics of each data-entry technique, the reader is referred to Chapter 19.

General rules

14.41 It is very important to analyze whether the information recorded on the questionnaire can be processed easily. For this purpose full collaboration is necessary between the group in charge of designing the questionnaire and the data processors. The questionnaire design must ensure that the presentation is simple. Too many printed codes can cause difficulty for enumerators in the field. In case of conflict between data collection and data processing requirements, priority is given, in principle, to data collection requirements for the simple reason that enumerators are often working under adverse conditions. A number of important aspects which may affect the ease of processing the questionnaire are given below.

14.42 An identification number should uniquely define each questionnaire and should always be numerical (not alphabetical), for example a sequential number. An identification code is also needed. This code should be as short as possible, although some redundancy or control code may be desirable in order to minimize possible errors and to help locate the correct identification code in case an error occurs. This is a nested code identifying unambiguously the agricultural holding. For example: two digits for province or state; two digits for district or the agroecological region; two digits for village or EA and a three digit correlative number for the agricultural holding within

EA or village. It should distinguish different questionnaires and in case of complicated hierarchy of questionnaires (e.g., several parcels per holding, several fields per parcel, several crops per field, etc.) each part will need to have its own code to allow sorting and linking of data. In case of sample enumeration, identification should provide sufficient information for assignment of expansion weights (strata, primary sampling units, area segments, etc.). The identification code should also allow distinction between administrative (or other) areas for which tabulation is required.

14.43 From the point of view of data processing one can distinguish five different types of questions:

(i) **Numerical value questions** (most frequent in agricultural censuses see Box 14.1): the answer is specified as a numerical value; e.g. total area of holding, number of persons, age of holder, number of animals (by each livestock type), etc.

(i) Indicate area under different land tenure types:

LAND TENURE TYPES	AREA IN Ha
1. Legal ownership or legal owner-like possession	
2. Non-legal ownership or non-legal owner-like possession	
3. Rented from someone else	
4. Other types of land tenure	
TOTAL LAND OPERATED (1 + 2 - 3)	

Box 14.1 Example of numerical value question

DRAFT

(ii) **Multiple-choice questions** (See Box 14.2): all possible answers are predetermined (such as yes/no) and the enumerator simply checks, circles, copies or tick only one of them. In this case the answers need to be mutually exclusive.

(ii) Indicate legal status of the holder (tick one box only):

- 1 Civil person
- 2 Group of civil persons
- 3 Juridical person

(iii) **Multiple-answer questions** (See Box 14.3): same as above except that the enumerator checks as many codes as apply.

Box 14.2 Example of multiple-choice question

(iii) Indicate type of fertilizers used on the holding (tick one or more boxes):

- 1 Mineral fertilizers
- 2 Organo-mineral fertilizers
- 3 Organic fertilizers
- 4 Bio-fertilizers
- 5 Manure
- 6 Other organic materials to enhance plant growth

Box 14.3 Example of multiple answer question

(iv) **Introductory questions:** (see Box 14.4) usually at the beginning of a section asking if any information in this section is available, or if not to skip to next section.

(iv) Do you hold any livestock on this holding? (tick one):

- 1 Yes – complete this section
- 2 No – go to the next section

Box 14.4 Example of introductory questions

(v) **Open- (or semi-open) ended questions:** Response is descriptive either because the possible answers are too many to be precoded or unknown. Examples of open-ended questions are: Name of holder or Name of holding, address or questions in the crop section of almost all questionnaires when no crop is preprinted but the enumerator is expected to enter it. Semi-open question refers to "Other, specify" part of the questionnaire which creates a similar situation.

14.44 For data processing, questions of types (i) and (ii) create no problem. Type (iv) is very useful, particularly at data entry stage, while types (iii) and (v) create problems and it is advisable to avoid them when possible.

14.45 Type (iv) introductory questions are useful as enumerators can skip whole sections without needing to enter all zeros as might normally be required. They are obliged, however, to give an answer to the introductory question even if the answer is no, otherwise the editor cannot determine if the section was just overlooked or properly skipped. Similarly, in manual data entry, introductory questions allow skipping to the next section with one keystroke.

14.46 Type (iii) multiple-answer questions, although easily processed, create some confusion for the tabulation plan and design of data processing codes. It is better to replace such questions with multiple choice questions (type (ii)), sacrificing part of the information (for example a multiple-answer question such as: "indicate one or more of the following sources where you get agricultural information (extension services, radio, television, newspapers, agricultural newspapers, input supplier, internet, other farmers, other (specify) can be simply changed to "main type of source of agricultural information").

14.47 Type (v) open-ended questions are frequent in agricultural censuses and create problems. Category "Other, specify" is difficult to process properly. At best it provides useful information for planning the next agricultural census. It is advisable, therefore, not to plan tabulation of these additional categories, but to keep them together under the title "other". If details are important, a list of these additional items should be obtained from other sources or from the pilot census. Other way to use these data are to develop codes for minor items and code the answers before data entry.

14.48 For crops, it is preferable to provide a list of those crops which are of interest as a part of the questionnaire and, in case of paper-based questionnaires, provide pre-codes for the enumerators' use printed in the questionnaire. In that case, when a short list is printed and the enumerator records many names of crops in the space allotted to "others" the coding takes time and can become a difficult task prone to errors. Generally the major crops and livestock types of the country are known and should be listed.

14.49 Another characteristic of the agricultural census questionnaire which creates difficulties in data processing is the complicated hierarchy of parts of the questionnaire such as parcels, fields, and plots. This can be simplified by collecting the information at parcel/field/plot level. This is justified in countries where most of the parcels have just one field or plot. Further simplification is found where crop data are collected at holding level. In this case aggregation is normally done by the holder, who probably knows the totals better than plot-by-plot. Similarly, some data on work on the holding can be collected in the form of aggregates (such as number and working time of employees on the holding by sex etc.). Simplification of the questionnaire in respect of hierarchy of various data sets may be the decisive factor in simplifying the organization of data processing and is, therefore, strongly recommended.

Country examples (Uruguay (at holding level) and Peru (at parcel level))- Links.

14.50 As mentioned in Volume 1 (see chapter 6 paragraphs 6.11 and 6.12 and chapter 8 paragraphs 8.1.4 and 8.1.5) an agricultural holding may have parcels in more than one village, district or province, sharing the same production means, such as labour, farm buildings, machinery or draught animals. In such cases, when the agricultural activity of the holding is operated in different administrative or geographical units the location of parcels (and livestock as well) could differ from the main location of the holding. This is especially relevant for large holdings. To enable the collection and tabulation of census data according to the location of parcels and livestock by administrative units, countries may wish to foresee in the census questionnaire the collection of relevant items (such as area of the holding by land use types and major crops; livestock by main types) with regional breakdown. Some countries include in the census questionnaire a special chapter devoted to the presentation of key relevant variables by administrative/ geographical units (such as communities, in Italy or counties in Hungary and Romania)

Country examples (Italy, Hungary and Romania.)- Links.

14.51 In some countries, when paper-based questionnaires are used, in order to decrease the volume of questionnaires, the chapter with regional data is presented in a separate form in an annex, which should be completed only if the holding declares that it operates parcels and/or raises livestock in different localities/administrative units. A relevant filter question is inserted in this case in the main part of the questionnaire.

Country examples (Moldova, Armenia)- Links.

Preparing questionnaires for scanning

14.52 When the census questionnaires are going to be scanned, additional considerations are needed. As it is explained in Chapter 19, there are different optical recognition methods (such as optical mark reading (OMR), intelligent character recognition (ICR)) and the specific instructions from the providers of hardware and software will lead to diverse layouts for the questionnaires. However, general recommendations can be made.

14.53 The first point to consider is the quality of the paper. Papers that are prone to wrinkle easily must be avoided because they can lead to erroneous reading. A second aspect refers to the color of different parts of the questionnaires. If the scanner recognizes only marks or text over white background, the questionnaire will have a different background for the sectors not to be scanned. A third aspect is the precision in the printing and cutting of all the questionnaires: each questionnaire need to have the reference points for scanning exactly in the same position to avoid incorrect reading. The same apply to the code bar to be printed in each page to link different parts of the questionnaire. Finally it is important that handwriting of text in questionnaires by the enumerators be as uniform as possible to common “model” handwriting so as to enable the work of the recognition software engine.

14.54 In addition to the benefits of the scanning technology for capturing the information, another advantage of scanning census questionnaires is that allows for the possibility of digitally filing and naming the scanned questionnaires. This increases the efficiency of storage and retrieval of the questionnaires for future use, particularly during subsequent data editing operations.

Designing electronic questionnaires

14.55 Electronic questionnaires (EQs) are used in the Computer-Assisted Self Interview (CASI) and Computer-Assisted Personal Interview (CAPI) methods. The questionnaire is set at the website of the census of agriculture and holders are asked to fill them online or uploaded in a table or minicomputer and filled by the enumerator.

14.56 Because of the fact that agricultural holders are familiar with filling paper-based forms it is advisable that the EQ looks like a paper-based traditional questionnaire without limiting the full potential of the EQ. The EQ should include navigational help information, drop-down menus, on-line edits and a help or “FAQ” section. Accessibility standards and regulations for visually impaired people may be considered in the design of a web electronic questionnaire.

14.57 In order to protect the confidentiality of the information, the access to the EQ should be done after a secure login process protected by a strong encryption.

14.58 Usually EQs are used as complement of other census taking techniques like paper-based questionnaires (personal interview and/or drop off – mail back and/or mail our-mail back) and/or CATI. For methods of remote data collection please refer to Chapter 18.

Processing electronic questionnaires

14.59 When using CAPI (Computer-Assisted Personal Interview) or CASI (Computer-Assisted Self Interview) there is not a separate process of data-entry. Data are captured at the same time that they are recorded in the electronic device. In such cases, it is possible that the layout and organization of the data collection instrument may differ from that of the paper questionnaire.

While many of the same principles (for example, clarity of wording, omission of unnecessary material) will apply to both CAPI and CASI, specialized advice should be sought regarding such issues as:

- ◆ the technology employed to present the questions to the respondent,
- ◆ the method of capturing the response, and
- ◆ quality assurance checks employed during the capture process.

Pre-testing of questionnaires

14.60 Although the members of the group who designed the questionnaire may be very competent, it is essential that its functionality be evaluated in the field by means of a series of pre-test surveys and pilot censuses. This issue is dealt with in 17.5-17.25. Where the census is conducted in more than one language it is important to test the questionnaires in each language version. Web-based internet questionnaires should also be tested. After taking into account the field testing experience and evaluating data inconsistencies and illogical replies, which might indicate that the questions were not understood by the holder and/or the enumerator, the questionnaires should be very carefully revised. All questionnaire tests including the EQs should be completed well in advance of the actual census to allow time to make the necessary changes to the questionnaires, and consequently to the instruction manuals and, if necessary, to again pretest. In the case of EQs, a group of experts could be assign to test the EQs (for example CANADA). In view of the large number of questionnaires and instruction manuals required, sufficient time must be allowed for printing.

Advantages and disadvantages of different types of questionnaires

14.61 Depending on the characteristics of the country, available resources and available technology each country must decide which type of census questionnaire suits better to its national conditions. However

some pros and cons of the different types of questionnaires are summarized in the table below in order to help in decisions about the matter.

TABLE 14.1 . Advantages and disadvantages of different types of questionnaires.

Paper questionnaires	Electronic based in handheld devices	Electronic web-based
Pros:	Pros:	Pros:
<ol style="list-style-type: none"> 1. Easy to understand 2. The informant can easily review his/her answers 	<ol style="list-style-type: none"> 1. Easy to manage in the field; 2. Some editing checks and jumps are automatic; 3. They allow smoother and faster interviews; 4. They allow the use of multiple questionnaires according to the answers received; 5. They allow quick links to maps, satellite imagery and GPS to help enumerators in the field work; 6. In the modular approach, it allows to sample holdings to apply supplementary modules during the taking of the core module. 7. Easily switch between different languages. 8. They allow drop-down menus. 	<ol style="list-style-type: none"> 1. Low cost; 2. Easy to implement. 3. Some editing checks and jumps are automatic; 4. Fast processing 5. They may be in different languages, 6. They allow drop-down menus.
Cons:	Cons:	Cons:
<ol style="list-style-type: none"> 1. Printing, delivering, handling of thousand or million of sheets of paper make difficult the field work; 2. Require special process of manual editing and data entry (manual / scanning) 3. Paper-based questionnaire can deteriorate easily 4. In case of the modular approach it is difficult to draw sample holdings . 	<ol style="list-style-type: none"> 1. They require previous experience in using the devices; 2. Cost of devices. But the cost can be shared with other surveys; 3. Special skills are required for programming the devices. 4. The country needs to have good internet or satellite connectivity. 	<ol style="list-style-type: none"> 1. Works well with educated respondents; 2. Respondents need to be in some way trained to respond rightly; 3. They require security to avoid hacking and protect confidentiality; 4. The country needs to have good internet/satellite connectivity.

14.62 In all cases it is important to highlight that rarely countries will use a particular type of questionnaire alone. It means that for some type of holdings or some regions paper-based questionnaires may be most appropriate while, handheld devices and web-based questionnaires can be used in other regions or for other type of holdings.

Instruction manuals

Introduction

14.63 The quality of data collected during a census largely depends on the quality of field work performed by the enumerators and the supervisors. Field staff must understand clearly all the details and procedures to be followed and learn a large number of concepts and definitions. It is almost impossible for them to become fully conversant with these during a short training period and they therefore need printed and/or electronic materials for reference. The manuals will enable them to review what they have been taught in order to master the subject matter and consult those items where doubts or problems arise as they proceed with the interviews. The instruction manuals serve two primary purposes. The first is to serve as an instrument of study during training courses and the second to provide basic material for reference during the census enumeration.

14.64 The manuals clearly establish the criteria and procedures to be followed and the work expected to be carried out during the census. The majority of the staff could carry out the census work and resolve the challenges they meet in their own way, but it is essential that they all proceed in the same manner at all levels (high-level staff, supervisors, enumerators); consequently, they must follow the same rules and guidelines. There should be only one definition for each type of agricultural information collected. With instruction manuals, it is much easier to achieve and maintain data comparability.

14.65 Regardless of the data capture methods used in the field (see Chapter 18) instruction manuals are paramount to ensure quality of the field work. Printed manuals, on-line manuals or manuals included in the software of data capture devices or any combination of them are needed. Therefore, the following recommendations apply to any method used in the field. Specific suggestions for electronic manuals are presented below when applicable.

14.66 Several other manuals can be prepared besides enumerators and supervisors' manuals, for example, training manuals, manuals for listing operation, manuals for key-punchers, editing manuals, manuals for data cleaners, manuals for the Post Enumeration Survey (PES), etc. In this chapter only manuals referred to data collection are presented.

14.67 Census manuals should be adapted to each census modality. In the following paragraphs, suggestions of points that should be highlighted in the manuals under each modality are presented. Of course, the above points referred to all manuals remain valid whatever be the adopted modality.

14.68 In case of the **classical approach**, with complete enumeration, manuals must emphasize the need of complete coverage of the assigned area. Clear rules, about the way enumerators should sweep the assigned enumeration area in order to avoid omissions or double counting of holding, should be an integral part of the enumerators' manuals. In the same sense, the supervisors' manual should stress in checking for complete coverage of the areas assigned to supervision.

14.69 If the **modular approach** is adopted, two cases need to be distinguished: **a)** when supplementary modules are implemented at the same time as the core module and **b)** when the supplementary modules are undertaken after finalizing the core module implementation.

In the case **a)** two sub-situations should be considered when preparing the manuals: i) if PAPI method of data collection is being used and ii) if handheld devices are used (CAPI). For the core module, instruction manuals are similar to the ones used in the classical approach when complete enumeration is taken: all holdings must be visited and census coverage needs to be assured. In the case a), the enumerator must perform some type of sampling during the field work. When CAPI is used, there is no problem because the software of the handheld device is built in such a way that automatically select the holdings where the supplementary modules will be applied. When PAPI is used, the manuals for the core module must clearly explain how to proceed in selecting the sample of holdings for the supplementary modules. In the case a)

only one manual for each type of field staff (one enumerators' manual and one supervisors' manual) is needed and it will detail the way to collect data for the core and the supplementary module items. In case ii) above the electronic manual for enumerators need to "open" only during the undertaking of supplementary modules. In case of printed manuals a good practice is to use paper of different colors for instructions about supplementary modules.

In the case **b)** above, different manuals need to be prepared: one to apply during the undertaking of the core module and the others for supplementary modules to be collected sometime after the finalization of the core module.

14.70 In the **use of registers as sources of census data**, from Vol 1 paragraph 4.9, two cases are distinguished: **a)** all the essential census can be based on administrative sources; **b)** some essential items can be obtained from administrative sources and some other items need to be get from survey/census data. Manuals have to recognize this distinction. In the first case, manuals should refer to how to collect the data from administrative registers to avoid duplications and omissions emphasizing in the need to preserve confidentiality of registered data if needed. They also must explain clearly any adjustment coming from different concepts of definitions in the registers vis-à-vis census definitions. In the second case, two types of manuals are needed: one for the on-desk work of collecting information from administrative sources and other for the field work. The latter with the same characteristics already explained.

14.71 In the **integrated census and survey approach**, (Vol. 1, paragraphs 4.13-4.16) articulates the agricultural census programme and a modular survey programme such as AGRIS conducted on an annual basis between two censuses. Specific manuals for the decennial census and for the annual surveys need to be developed following the above detailed lines.

Timely preparation of manuals

14.72 The instruction manuals should be prepared well in advance of training and made available at the beginning of the staff training course. It might be advisable to develop the manuals taking into account the results of training course for census staff. It is highly preferable to have draft manuals at this stage. The training of each type of census officer in the field will normally be the responsibility of the higher or headquarters-level officers who have just received their training (See Chapter 15), and it is therefore essential that they are able to rely on a document which will serve as a basis for transmitting the instructions to be followed in the census work. It should also be kept in mind that the manuals can be finalized only after the census questionnaires and various administrative procedures are finalized, which is another reason why early census preparations are essential.

Authors of the instruction manuals.

14.73 The instruction manuals should be prepared by people who are conversant with conducting an agricultural census or other statistical operations, not only from a theoretical but also from a practical point of view. This is particularly important so that numerous realistic examples can be developed. Through their experience in the field the authors of the manuals will know the problems which arise most frequently during the enumeration period and will be able to furnish practical solutions and guidelines for resolving such problems.

14.74 Often, the technical staff of the agency responsible for the census is newly trained and although they know the technical aspects, they have little or no field experience. In this case, they should consult widely with employees, including experienced enumerators and supervisors who have participated in previous censuses or surveys so as to learn from their experiences and take advantage of their expertise in writing the manuals. If the first step to be taken is the updating of manuals of a preceding census, it is necessary to consult the staff who reviewed the questionnaires (for example editors or data cleaners) to

know what questions gave rise to problems and examine the causes of such problems, and if there are mistakes in the instruction material they can be corrected. This information should exist in a technical report which may have been written after the previous census. In many developing countries this is not so; consequently, one has to rely on verbal information from former officers. The experience gained in the pilot census and in pre-testing should be fruitfully utilized in revising and preparing manuals. The authors of instruction manuals must remember that the staff who participate in the census are a very mixed population; consequently, the manuals must be written in simple language to the staff having the lowest level of education but meeting recruitment requirements for the job. The inclusion of explanations and examples in the manuals which may appear very elementary is justified. It is usually a very good idea to take into consideration manuals from neighboring countries with similar cultural backgrounds, particularly if the census is being organized for the first time.

Country examples (Romania, Nicaragua, Saint Lucia)- Links.

Presentation of the instruction manuals

14.75 The language of the instruction manuals must be clear and simple so that they are easily understood. Idioms should be avoided, since their meanings may vary in different provinces of the country. If there are several local languages in the country, manuals could be prepared in any of them as for the questionnaires. As much as possible, words which can be interpreted in many ways, or words which differ in meaning from one locality to another, should be –explained, (for example in some region of a country the word “community” is used whilst the word “settlement” is employed to name the same concept in another region) or the desired meaning should be emphasized. In case of electronic manuals, aids on alternative uses of definitions of terms in different parts of the country can be provided. Electronic manuals allow having links to dictionaries and to glossaries of terms built ad-hoc which gives a large flexibility in this sense.

Format and content of the instruction manuals

14.76 The instruction manuals should not be too large, preferably in the range of 45 to 60 pages and for paper-based manuals small enough to fit conveniently in a handbag. Care, however, must be taken to ensure the manuals address all points of the work and is easily readable

14.77 In case of printed manuals, the size of the print used in the manuals is an important factor. It may be recalled that in many cases field training and data collection are carried out in places where light is inadequate and reading of small print becomes difficult. The chapters and paragraphs should be separated, with titles in large lettering and preferably with some drawings enabling the subject to be easily identified. When chapters are very long, drawings or illustrations may also serve as points of reference and make it easier to locate the subject.

14.78 In case of printed manuals, is also customary to leave a very wide margin on the left of the page in order to highlight the points which are addressed in each paragraph and which enables the subjects to be found quickly. The margins should also be wide enough to permit the field staff to record any notes which they deem necessary to clarify points which they find confusing. During the training course the staff should be encouraged to do this, since many of them will have been taught not to write in books. In case of the use of electronic manuals, a paper pad or any other device like a tablet to take hand-written notes should be used for trainees at the training courses.

14.79 As already stated, the census officer or enumerator will not be able to memorize the manuals, but must be perfectly familiar with them in order to know how to find specific subjects. For this purpose the illustrations and marginal subject headings of the paragraphs are of great assistance. To facilitate the consultation work, the manuals should have an index of chapters and paragraphs. These should be numbered and one way of doing so, which is convenient and often used, is to use for the paragraphs the number of the chapter to which they belong, followed by a full-stop and the progressive number

corresponding to the paragraph, for example: *Chapter 1 General Information; 1.1 What is an agricultural census?; 1.2 Objective of the census; etc.* Electronic manuals allow to link different parts of the manual and to forward the reader directly from the list of contents to the desired paragraph.

14.80 When using paper-based manuals, it is important that the paper used for manuals be of good quality, so as to withstand frequent handling without becoming torn or damaged. The cover page should be weather resistant and of a colour which attracts attention so it can be located easily among census papers.

14.81 Different types of census staff exist, namely the enumerator, the supervisor, and higher level or headquarters staff (see Chapter 15), and the use of the manual content is different for each of them. However, there are a series of issues which are common to all census officers, such as the purposes of the census, basic definitions, explanations of the legal basis, how to fill in the questionnaire, etc. In many countries it is customary to prepare only one manual, including a part with the common items and a part for each level of officers in which detailed instructions pertaining to their work is given. In this way, it is easy for everyone to find and read the part relating to their particular work. In some countries separate manuals are printed, but this system has several potential problems. Sometimes separate manuals are prepared but printed together forming a single volume. Presentation of electronic manuals in a tablet or similar device facilitates the existence of multiple manuals in one, with quick links to any part of the manual (see paragraphs 14.67 to 14.71).

14.82 Whichever form is chosen to present the instruction manuals, the order of the items must be logical and consistent with the relevant questionnaires. At the beginning there will of course be an explanation about what the census is, its legal basis and the reasons for taking the census. This explanation must be within the grasp of the census officers and provide them with the necessary elements so that they in turn are prepared to give answers to the holder whom they are going to interview and be able to respond authoritatively to any other person (or authorities) whose collaboration they might need.

14.83 The manuals should deal with the following issues:

Census operation. A clear understanding of the objectives, procedures and definitions affecting census work promotes efficiency in the enumeration process. There should be provision for such information in the enumerator's manual. Possible considerations for such clear understanding are discussed below.

Objectives and nature of the census. In general, regardless of the development of a country, the objectives and nature of the agricultural census are the same. It should be made clear to the census staff that an agricultural census is an inquiry on the structure of the agriculture sector of a country. Information on the statistical unit, the agricultural holding, is collected. The objective is to include all holdings in the scope and coverage of the census. For example, if the modular approach is being used, clear explanations about the differences between holdings in the core module and in the supplementary modules are needed as well as references to the sample. After it, a separate manual for taking the supplementary sample modules can be prepared. In case of using electronic manuals this manual for the supplementary modules is built in the same electronic support and linked to the main manual.

Organization responsible for the census. In a census operation, many problems may arise if the guidelines are not well defined and if the organization is not clearly stated. It is, therefore, necessary to include in the manuals the corresponding organization, mentioning the office responsible for the census, its various provincial offices involved in the census work, as well as the officials in charge, and the position within the organization of the bodies which are especially created for census purposes, such as census committees (see Chapter 3). This description of the census organization, corresponding to the census operation which is about to begin, will enable each officer to understand the role he/she plays in this structure. The work of each census officer

will be explained in a general way, so that they understand the fundamental purpose of their work with each step described in detail in the body of the manuals.

Legal aspects and confidentiality. The legal responsibilities and entitlements should be mentioned in the manuals. As in many countries a law on statistics exists and in some a specific decree will have been promulgated to facilitate the census work, a corresponding chapter should be based on these documents. The field staff should be provided with a copy of the decree so that they feel they have sufficient authority to carry out their work, but stressing that they must always try first of all to convince the holder to give information assuring the confidentiality of data provided according to the law. Only in extreme non-response cases use the argument of these sanctions. Emphasis should be on the obligation for census officers to maintain the confidentiality of data obtained, plus some precautions, such as keeping completed questionnaires in a safe place, carrying out the interviews without witnesses (not in the presence of anyone who may be accompanying the census officer or the holder), and other precautions deemed necessary.

Obligations and rights. A statement should be prepared on the obligations and rights of census officers. Those agreements were accepted in their capacity as civil servants working specifically on the census, such as to be kind and courteous with the respondents, not to discuss political or religious matters, not to ask the producers for food or anything else, and not to sell anything, etc. The right of being paid for their work and other rights like to be treated courteous and kindly by their supervisors should also be stated.

Definitions and concepts. A chapter should be devoted to the definitions and concepts-utilized in the census, which must be understood and memorized by the field staff. Among them are the statistical unit (often the agricultural holding), geographic coverage, time reference periods (for example, the agricultural year for main agricultural activity or area of holding according to land use or the day of enumeration for sex and age of holder, etc. For details of reference periods see Vol I Chapter 8) of data to be collected, and a short explanation of sampling methodology, if applicable.

Map-making and reading. An important aspect to be explained in great detail and very clearly is that of map-reading, because the majority of the staff is not accustomed to using maps, making sketches and performing other work on maps. Although this is a subject which might be considered in common for the field staff (See Chapter 12), it presents slight differences for the various census officers, since they do not all have to perform the same work on maps, unless involved in quality control and verification of data collection.

Use of GPS. Supervisors and/or enumerators might be provided with GPS devices for establishing the coordinates of the working area and sometimes the coordinates of the location of the holding (See Vol. I:paragraph 8.1.2). The manuals should clearly explain the use of the GPS also for measuring areas where needed.

Uses of data capture devices. In case of CAPI is employed, the use and management of the devices used for data capture (smart phone, notebook, tablet, etc) should be thoughtfully explained in the manuals. The characteristics of the software developed for data capture along with a list of troubleshooting also needs to be incorporated in the manuals. (See Chapter 18). There is also a growing use of GIS and satellite images on the electronic devices that can help the field staff in moving across their area of assignment. (See Chapter 18). Census data collection methods, Use of technology for census data collection).

14.84 There are some accepted, general indicators which may help avoid mistakes, learn how to conserve their efforts, establish effective working relationships with the respondents and accomplish their work assignment in a short time.

Manual for the Enumerator

14.85 The basic contents of the enumerator's manual may be as follows:

- ◆ Why the census is being taken and its importance
- ◆ Objectives of the census (Vol I. Chapter 8, paragraph 1.7)
- ◆ Uses of census information
- ◆ General information about the census
 - Nature, scope and coverage(including thresholds, if any, of the particular census)
 - Definitions and procedures. General definitions like “*What is a census of agriculture*” (Vol I, Chapter 8 paragraph1.1), “*What is meant by structural data*” (Ibidem), and main definitions from the “Glossary of terms “at the end of Vol I like: agricultural holding, agricultural holder, agricultural land, census reference day, census reference year. The main operational procedures will also be in this section, for example: census modality applied by the country, types of maps to be used; how the enumeration areas were defined, how the list of holdings were identified (if appropriate), how to identify the proper EA to work in, and how to proceed once in the assigned EA.
 - Method of collection. If PAPI, CAPI, CATI, CASI or a combination of data collections methods are going to be employed.
 - Time reference. Span of the census field work (for example: “it is foreseen that the field work lasts 20 days”).
 - The census field organization (organization chart)
- ◆ Responsibilities and rights of census staff with emphasis on enumerators (See Chapter 15)
- ◆ The interviewer and interviewing:
- ◆ Desirable attributes of the interviewer
- ◆ Preparation for the interview
- ◆ Tips on interviewing
- ◆ Resolving common problems in interviewing
- ◆ The questionnaire
- ◆ Item by item explanations of exactly what kinds of data are expected for each question and how to make the proper entries. An image of each section of the census questionnaire should be displayed (in any support: paper or screen) and detailed instructions about the concept involved in the question, the reference date and how to fill the questionnaire.
- ◆ Other census forms
- ◆ Mapping and listing forms
- ◆ Conversion tables and related tables.
- ◆ Objective measurements (when envisaged)
 - Measurement of areas
 - Measurement of yield (crop-cutting)
 - Use of pocket calculator and/or GPS for area measurement
- ◆ Use of data-capture device (when CAPI is used)
- ◆ Entering data
- ◆ Correcting data entry
- ◆ Saving census questionnaires
- ◆ Transferring the questionnaires
- ◆ Troubleshooting of the device

Annex 1 Administrative instructions

Annex 2 Examples of completed questionnaires

14.86 The manual should include a general description of the work to be carried out, explaining that the enumerators will travel through the areas assigned to them, identify the holdings and ask each holder for

the information requested in the questionnaire or questionnaires which have been designed, and that they will abide strictly to the instructions given to them.

[Links to country practices: Romania, Nicaragua, Uganda, Costa Rica, etc. Additional examples to be provided by Paul, Mukesh, Eloi to cover all geographical areas.](#)

14.87 The manual should also include a description of the data collection method. It is advisable to prepare an annex to the manual containing a series of examples and exercises on how to fill the questionnaire illustrating interviews with holders, and how interviews should be conducted, to familiarize the enumerators with the technique of interviewing (see also Chapter 18). Enumerators should be aware that some questions are a cross check of previous answers received, and the response to such questions might require the enumerators to revisit previous questions and responses. Exercises explaining the definitions and basic concepts and giving some information on working with or on maps should also be included. The exercises can be presented as a separate booklet which will be very useful for the enumerators to study on their own so as to become thoroughly conversant with the subject. It can also be used by area coordinators and supervisors for the same purpose and during training courses for staff under their jurisdiction.

Manual for the Supervisor

14.88 The supervisor's manual may include the following sections, in addition to what is suggested for the enumerator's manual:

- ◆ General responsibilities of the supervisor (See Chapter 15).
- ◆ Selection, recruitment and training of enumerators:
 - Role of the supervisors in the training courses for enumerators;
 - Role of the supervisors in the final selection of enumerators.
- ◆ Preparation of mapping, listing and other census field materials. Usually maps and draft listings would come from the central census office. However, supervisors must:
- ◆ Review the maps to assess their accuracy and make the needed changes in agreement with the provincial coordinator;
- ◆ Review and adjust the lists of holdings coming from the central or provincial census office
- ◆ Field supervision:
 - How to check census questionnaires;
 - In what cases return questionnaires to enumerators;
 - How and when dismiss and substitute negligent enumerators
 - How and when re-visit censused holdings;
 - Procedures for a first editing of census questionnaires;
 - Filling the field work progress report..
- ◆ If CAPI is used a detailed explanation on how proceed with electronic questionnaires received, their checking and edition and the way the supervisor return his/her feedback to enumerators is paramount.
- ◆ Preparation of summary of most important data (when envisaged). In some cases a preliminary census report is planned in order to advance census results. It is common to prepare this report during the supervision of census questionnaires in the field. In such case, the supervisor's manual should clearly explain the procedure.

14.89 In order to discharge the duties of the supervisor it is necessary that guidelines as recommended be prepared so that all procedures will be uniform.

14.90 It is essential that the manual emphasize the work of the supervisors as mainly supporting and assisting the enumerators to improve the quality of their work and to coordinate the data collection activity. Supervisors which are in direct contact with the enumerators are in the best position to assist and encourage them to work efficiently and correctly.

14.91 The general description of the supervisors' work is extensive since their functions vary (See Chapter 15) In summary, they include work prior to the fieldwork, during the census field work and after the fieldwork has finalized in the areas under his/her supervision. In countries where the field area is measured, supervisors may be equipped with GPS or other measurement devices. Supervisors will have to deal with many other administrative aspects such as checking the extra expenses of enumerators, handing out wages and hiring and dismissing enumerators. After the census they will make a final report and check expense claims which remain pending. They may also be assigned further duties: the participation in publicity campaign, promotion of the census and even assisting with the formation and setting up of the census committee, the latter when their work area coincides with an administrative division.

14.92 The distribution of work among the enumerators should be equitable. Inequity creates friction among the staff and is detrimental to the quality of the work performed. If, through lack of information, it is feared that the distribution is not equitable, the enumerators will be advised and will be asked to report frequently to the supervisor to receive new instructions. If the census is based on a sample it should be specifically emphasized that this procedure is based on certain statistical principles and the instructions should be followed closely, since unauthorized modifications may seriously distort results obtained from the census enumeration.

14.93 The supervisor will often be responsible for training enumerators. (See Chapter 16.) Guidance regarding the subjects which must be taught during the training course should be included in the manual as well as the approximate time devoted to each subject. In the absence of a specific "Training Manual", the Supervisor Manual should contain a course agenda to ensure that all subjects are covered, each given its due importance.

14.94 Supervisors should be explained the type of facilities needed for conducting the training course and the material which will be made available. The importance of supplementing the theoretical training of the staff should be stressed with practical training consisting of interviews and census work in the field. Emphasis should be put on the fact that even with good training and competent candidates as enumerators, field practice is still necessary, because field practice reinforces the theoretical training. More details about training organization can be found in Chapter 16.

14.95 Instructions will be given in the manual regarding the number of interviews which the supervisor has to observe and how it should be done without embarrassing either the enumerator or the holder, and how to give guidance to the enumerator on the basis of what was observed. In addition, during the supervisors' field visits they will check a sample of questionnaires completed by the enumerator.

14.96 One of the functions of the supervisors is to ensure that the census is finished on schedule. For this to happen they must monitor the progress of the field work. Supervisors will be given instructions on how to keep a suitable record to enable them to evaluate the performance of their enumerators. This task is highly facilitated when using CAPI with GPS which allow almost in real time monitoring/progress of the field work including the statistics automatically calculated about the performance of each enumerator. **(Example Cote d'Ivoire)** Otherwise printed form are needed on which to make the relevant notes. They will also have printed forms for reporting to the provincial office on the progress of the work, and the manual will state the intervals these reports must be made (see Chapter 17). The supervisors should receive guidance in the manual on how to resolve problems related to non-performing enumerators who were dismissed for such situation, either by hiring staff who attended the training courses and passed the examination but were not selected, or by extending the census period and dividing the work among one or

more enumerators who have been working well and may finish their own assignment earlier and who can be transferred to the areas needed once they have finished the work originally assigned to them.

14.97 It should be stressed in the manual and during training that supervisors must study carefully the guidelines given to the field staff for dealing with problems, they must be in a position to solve such problems and only in extreme cases will they refer such problems to the area coordinators for instructions on how to proceed.

14.98 The enumerators should inform supervisors of interviews which could not be carried out because of the refusal of holders to give information, or other reasons, in which case the supervisor must try to complete the interview. The manual should contain suggestions on how to proceed in case of refusals, such as again approaching the holders to try to reason with them and, when such attempts fail, to contact someone with influence who is willing to try and convince reluctant holders to respond to the questionnaire. This could be the religious leader, the leader of a holders' trade union, or the president of an association, etc., or some government authority, as considered appropriate in the community. In spite of these endeavors, it will not always be possible to obtain the desired information. Instructions should be given to the supervisor on how and when suggest to the census office the application of sanctions which have been established by the legislation.

14.99 The supervisors must follow the work of enumerators. In this sense, the editing of the completed questionnaires is a major task which the supervisors must perform. The editing of all questionnaires immediately after the data collection at early stages (during the first three or four days of work) will enable them to detect errors made systematically by any enumerator, to immediately give the necessary instructions so as to rectify such errors. As work progresses and enumerators complete more questionnaires the supervisors will have more work to perform and will not be able to edit all questionnaires; therefore the manual should contain some very simple sampling procedure which supervisors can use to continue editing (See Chapter 7). Assignment of supervisors should be such that they can do a simple check and editing of questions deemed essential for any questionnaire completed in their district. In case that CAPI is used, the completed questionnaires are electronically sent to the supervisors and they should be able to run some type of automatic editing prior to transmit edited questionnaires to the main office.

14.100 It is very important to note that the editing of questionnaires in the same area in which they have been completed makes it easier to correct erroneous data contained; instructions should, therefore, be given as to how these data should be corrected. Whenever possible, that is to say, when communications and available time permit, a badly filled-in questionnaire should be returned to the enumerator to rectify the information with the help of the holder. When supervisors edit questionnaires by hand they should all use a specific colored pencil. In case of paper-based questionnaires, they should not erase or obliterate the enumerator's recorded data but strike through the incorrect entry only once and enter the correction next to the question.

14.101 The supervisors are often asked to make summaries of the main census results being obtained. This summarizing task is also entrusted to enumerators in some countries. It will be indicated in the manual how often these summary reports should be sent. Since the supervisors have to prepare a final report, they must be given instructions on how to do so, be generally provided with guidance on the subjects which must be covered without a lot of detail, since lengthy information supplied is often not read. The use of CAPI can facilitate the task of summarizing main results.

Manual for the provincial coordinators

14.102 The provincial coordinators' manual may include the following sections in addition to that included in the supervisors' manual:

- ◆ General responsibilities of the coordinators

- ◆ Selection of applicants for the supervisor and enumerators posts:
 - Role of provincial coordinators in the selection and recruitment of field supervisors
 - How to act with field supervisors in the final selection of enumerators.
- ◆ Training of supervisors.
- ◆ Receipt and editing of questionnaires and other forms completed in the field:
 - Details of the process of reception, editing and revision of census questionnaires and other forms;
 - Assess the quality of supervisors' work and ways to correct issues about field supervision.
- ◆ Dispatch of progress reports on the census.
- ◆ Summary report on preliminary data. If preliminary data were prepared by census supervisors, the provincial coordinator must review and consolidate them. In some other cases, the provincial coordinator is charged with the preparation of preliminary provincial data.
- ◆ Instructions on administrative aspects in relation to the checking of expenses, payment of wages and—allowances, rejection of faulty work, application of sanctions to officers, contractual arrangements, etc.
- ◆ Dispatch to the central office of all the documentation dealt with.
- ◆ Final Report. Format the same as that for the supervisor but containing more subjects.

14.103 The provincial coordinators will be responsible for the census in the province assigned and the description of their basic functions may generally include:

- ◆ setting up a provincial office, negotiations with government authorities, with other persons and with various agencies;
- ◆ promotion of the census, hiring and training of the supervisors, distribution of field staff, receipt and distribution of the census material;
- ◆ general supervision of the field work,
- ◆ receipt and revision of the completed documentation;
- ◆ payment of the wages;
- ◆ summary of preliminary data, dispatch of all the completed documentation to the central office and preparation of a final report. If they have a technical and/or an administrative assistant, they will also have to coordinate such work (See Chapter 15).

14.104 The manual for the provincial coordinators is often either considered not necessary or it is done in a very short form. Since provincial coordinators are usually few in number in most countries, the description of their duties and related instructions may be prepared in a very short informal format instead of a manual. Nevertheless, countries with long traditions in census and survey taking usually prefer a more detailed manual. Communications between the central census office and the provincial coordinators can be reduced and problems avoided if they possess good instructions. Provincial coordinators should be instructed on which government agencies they can approach in order to obtain office accommodation and equipment, or whether they will have funds available for this purpose.

14.105 The provincial coordinators should be given very clear instructions on the formation of the census committees, who should comprise them, the approximate number of members, what the functions of the committees are, when they should start to function and when they will conclude their mission, and other details which are considered important so that the committees are of real assistance to the census work.

14.106 The provincial coordinators should be advised on how to handle and control the census documentation they will receive from the central office and what action they should take when forms are missing. For example, in some cases they may authorize their printing or reproduction locally.

CHAPTER 15 STAFFING

This chapter centres on staff requirements for conducting an agricultural census. Census staff, under the responsibility of a census coordinator, are basically composed of two categories: the office staff and the field staff. The success of the census depends on the efficiency, quality, coordination and dedication of the census staff. Many topics covered elsewhere in this publication are closely related to census staff. The attention of readers is drawn particularly to the Training Programme (Chapter 16), and to the Organization of Field Work (Chapter 17).

Introduction

15.1 Human resources is one key factor in management and execution of massive and complex projects such as an agricultural census. Good census plans, both strategic and operational, and their implementation require personnel with the qualification and expertise in census undertaking and managerial skills.

15.2 Human resources usually account for the largest share of the budget for most agricultural census operations. The effective allocation of resources, which is one of the greatest challenges faced, will allow achieving the highest efficiency. Timely arrangements are necessary to secure the proper number and type of staff required for each of the various stages and operations of the census.

15.3 The agricultural census is an important basis for developing and improving the ongoing system of agricultural statistics. Therefore, resources developed and groundwork laid by the census, in particular, trained field staff, should be used as much as possible in various other surveys and censuses. Reciprocally experienced and trained staff from other statistical data collections such as a population census, should also be considered as potential staff for the agricultural census.

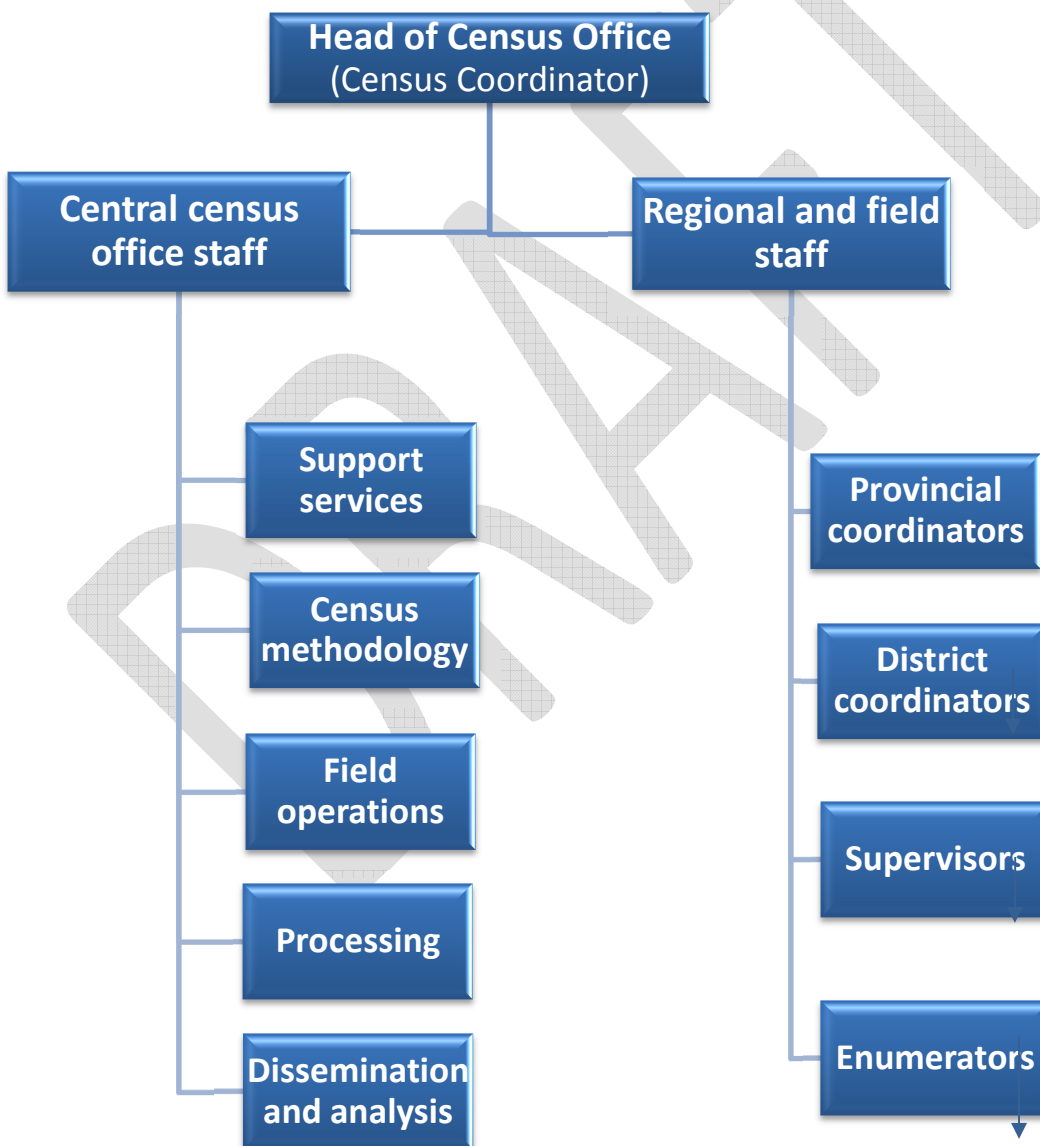
15.4 This section focuses on the major aspects related to human resources and their principal assignments when undertaking a census of agriculture in order to achieve a well-executed project, within the set timeframe and budget. Staff resources include census office staff and field staff. A generic organizational structure of census staff is presented below and special attention is given to duties, responsibilities and consideration of recruitment of office and field staff.

15.5 Characteristics of the census staff vary according to the census modality adopted. In classical, modular and integrated census/survey modalities, large numbers of field staff will be needed with largest numbers for classical census modality when complete enumeration is used. When combined census with administrative data modality is applied, less field staff may be required but more office staff will be needed for the management, organization and cleaning of large administrative databases. Implications of the choice of the census modality on the staffing process are also discussed in this section.

Organizational structure of census staff

15.6 In Chapter 3 Institutional Framework, the generic structure of census organization was presented. Figure 15.1 is an example and refer, mainly to the organization of census staff. Organization of census staff may depend of the institution responsible to carry out the census. In some cases the general organization is vertical (most of the processes of a survey are concentrated in a single office) in other horizontal (processes are divided in different specialised and cross sectional offices, e.g IT office, methodological office, data collection office etc.) The two options impact on the number, the skills of people and the tasks of the central census staff office. The organizational census structure and responsibilities of staff can also be defined through legal enforcement, when an article or a paragraph within the Census Law/Act/Decree, dictates the assignments and responsibilities to be performed by the census personnel. (See Chapter 2)

Figure 15.1: An example of Structure of Census Staff



15.7 The staff requirements for an agricultural census can be generally divided into two main categories of personnel:

- ◆ **Office staff** represent personnel needed for overall management of the census, planning and executing the census operations, including training of field personnel, data processing and analysis, and dissemination of census results.
- ◆ **Field staff** represent the personnel for field operations, including data collection and supervision activities.

15.8 The census staff involved in field operation and/or monitoring the field operation should be given a "census identity card" which they should carry any time they participate in a census operation. This is especially important for field staff in order to establish official creditability with respondents during the data collection phase.

Office staff

15.9 The **national census coordinator** is the person responsible for the census and could be the head of the census agency (i.e. the agency responsible for conducting the census according to the legislation) or a person designated by him/her. This person is the leader of the census office. He/she has the overall responsibility of the census and should, therefore, be sufficiently qualified in statistics, have extensive experience in the management of large-scale statistical operations, including agricultural censuses and surveys, and be fully familiar with national agriculture. The census coordinator has the ultimate line management responsibility for the eventual delivery of census goals and will usually report to the census agency executive. Depending on country legislation, the census office may be administratively located in different agencies. In some cases the NSO is responsible for undertaking the census of agriculture and the census office may be a separate (and transitory) unit inside NSO. In other cases, the Ministry of Agriculture may be responsible for conducting the census of agriculture. Again it may establish a separate, unit (which could be transitory) conducting the census or not. In all cases the national census coordinator should be the head of such census office.

Links to country practices: India, China, Romania, Italy, Spain, Poland, Russia, Armenia, Brazil.

Census coordinator responsibilities are:

- ◆ Planning, management, organization and coordination of all census activities;
- ◆ Overall implementation of work plan and modalities;
- ◆ Providing guidance on strategic issues to those involved in the census;
- ◆ Chairing the stakeholders consultation, including users– producers’ workshop and reconciling differences in opinion and approach between stakeholders;
- ◆ Ensuring that the census’s programme’s aligns with the requirements of stakeholder groups;
- ◆ Communicating expectations and critical decisions to the executive management of the census agency;
- ◆ Efficient allocation and use of census resources;
- ◆ Periodically report on the status of implementation of the census activities to the executive management of the census agency and to the Census Steering Committee;
- ◆ Organise regular meetings with office staff responsible for the different areas of census work and with provincial census coordinators to assess progress of census;
- ◆ Addressing any issues that has major implications for the census programme.

15.10 In some large countries, a **provincial census coordinator**, supported by trained and experienced statistical personnel, could be appointed in each province. The **provincial census coordinator** should have qualifications and experience suitable for the level of responsibility in the organization of the census and be familiar with the province specificities. He/she will have the same responsibilities and duties as the national census coordinator at provincial level. Besides, the provincial census coordinator should normally report to the national census coordinator regularly.

15.11 The **office staff** (i.e technical staff) would work mainly at the central census office and in some cases in provincial/district offices. The office staff is composed of technical and other(s)/non-technical staff. The technical staff would consist of statisticians, IT/data processing staff and in some countries, subject matter staff. When CAPI or CATI/CASI is used, IT staff need to work very closely with statisticians to prepare electronic questionnaires, data validation routines and survey management protocols. The non-technical staff would consist of accountants, logistic personnel, and others who generally belong to a central service and are liable to periodical transfer. The office staff could be divided into two main categories according to the operational phases.

15.12 The **first category** of office staff would be in charge of planning the technical aspects of the data collection. They have the following duties and responsibilities:

- ◆ designing the census methodology and instruments;
- ◆ analysis and dissemination of census data;
- ◆ recruiting and training field staff;
- ◆ monitoring field operations;
- ◆ designing the tabulation and analysis plan;
- ◆ analyzing the data and drafting the final report.

15.13 When recruiting or appointing staff for this category it is important to consider that it should include professionals with degrees in statistics, mathematics, economy and related fields and formal training in statistical methods and sampling techniques. These professionals should be specialized in the following fields:

- ◆ Planning and administration;
- ◆ Agricultural census organization and monitoring;
- ◆ Agricultural census methodology and sampling techniques;
- ◆ Data tabulation, analysis and dissemination;
- ◆ Quality control and evaluation;
- ◆ Training of field staff.

15.14 A special category of technical staff is needed when data collection is planned to be performed using Computer Assisted Personal Interview (CAPI) or any other non-paper based interviews (CATI, CASI) (See Chapter 18). In such case, the need for developing software for data collection, the preparation of electronic questionnaires and manuals and the management of completed questionnaires among others require qualified office staff. This category should include specialists in the use of handheld devices and associated software packages. Some general professional staff would complete routine work, editing and checking questionnaires regardless of method of data collection, and computer output, etc. When decentralizing operations, it should be noted that the transfer of secure data must be maintained via a secure network. Technical assistance and expertise, to ensure that this is feasible, should be obtained.

15.15 The **second category** of office staff includes **data processing staff**. Data processing could be done in the head office or in decentralized locations. If processing is decentralized to a number of locations, the

structures can vary according to the tasks carried out at each centre. For example, one centre may be responsible for a particular process (e.g data entry), with other processes (e.g coding) conducted at different centres. In other cases, multiple processing centres that are responsible for the complete processing of data for the surrounding provinces, may be established through the country. Duties and responsibilities of data processing staff include:

- ◆ the organization of data processing activities;
- ◆ management of data entry personnel (if any);
- ◆ elaborating data entry and editing programs and tabulation programs.

Where possible, these personnel should be recruited among individuals with degrees in computer science (analysts, programmers) and experience in census and survey data processing.

15.16 When some computer assisted method is used for data collection efforts need to concentrate in consistency checking, error detection and cleaning files. Therefore, the profile of this staff need to be somewhat different with staff specialized in computing and management of databases. When this staff is not available, extensive training may be necessary. When paper-based questionnaires are used in addition to these personnel, staff is needed for data entry, manual coding and editing including correction of errors detected by computers. This staff should have at least high school education and may be recruited from successful field enumerators and supervisors.

15.17 If the census involves sampling, a sampling specialist should be included in the office staff to advice on all sampling related activities. In case of use of registers as sources of census data a group of specialists with broader skills and knowledge of use of administrative data in statistics is needed. In this case a specialist of record link techniques should also be included in the census office. He will supervise the process of preparation of large administrative databases for linking with the census database as well as the process of retrieving administrative data.

15.18 It is desirable to develop a permanent data processing staff in order to ensure continuity and avoid having to constantly train new staff. This is not always possible considering that census data processing is a major task which should be completed in a short time (around one year).

Field staff

15.19 The **field staff** plays a critical role in the quality of the data collected in the census. The number of field staff required for the agricultural census is usually large. It is obvious that the success of the census in providing useful results depends largely upon the proper selection and training of this staff, considering that the agricultural census is a comprehensive data collection operation.

15.20 It is important to establish the broad operational framework under which the structure of the field workforce must operate. The number of levels in the hierarchy depends on the country situation. The factors to be considered are the administrative structure of the country, number of administrative levels, distribution of agricultural holdings within the country.

15.21 At the base of the hierarchy is the field **enumerator** whose work is monitored by local **supervisors**; however, it should be recognized that enumerators are the key to the success of the agricultural census. On the top of the hierarchy are the **provincial supervisors** who are appointed under the national and provincial census coordinators to provide quality control and technical guidance of field work.

15.22 The census office needs to determine a number of key factors, when formally determining the structure of field staff. These are: i) roles and responsibilities of each level; ii) time available; iii) staff ratios between the different levels.

- ◆ The roles and the responsibilities at each level will vary and depend on the basis of enumeration. Several enumerators will be dealing with one supervisor, and several supervisors will be dealing with the provincial supervisor or his deputy. The provincial supervisor could also have several deputies which will deal directly with supervisors. The roles and responsibilities of each level must be clearly defined in the respective instructions manuals (see Chapter 14) and reinforced under the training (see Chapter 16).
- ◆ Another factor in establishing the structure of field staff is the amount of time required for communication between people at different levels in the hierarchy. For example, each contact between enumerators and their supervisors will take time. Where distances are relatively great, the travel time required for face-to-face contact can be a significant part of the time required for supervisors to undertake their duties. The use of information and communications technologies is critical in those cases. Going from less developed to more developed use of such communications methods countries should consider to advance following these steps:
 - Face-to-face contact between supervisors with their enumerators;
 - Supervisors' e-mail address for enumerators to forward questions or doubts;
 - Supervisors' mobile phone number to receive SMS and calls;
 - Internet groups comprising either one supervisor and his/her enumerators or several supervisors and their enumerators to configure a discussion forum on census data collection;
 - Smart-phone-based groups similar to that of internet groups;
 - Development of handheld devices' apps for consulting census aspects.
 - Set-up of a centralized website that all employees have access to and where bulletins/information/updates can be accessible to all staff.
- ◆ Finally, staffing ratio is another factor in establishing the structure of field staff. Three types of staffing ratio have to be considered: provincial supervisor/ deputy provincial supervisor ratio, deputy provincial supervisor/supervisor ratio and supervisor/enumerator ratio. The **provincial supervisor/ deputy provincial supervisor ratio** depends to a large degree on top level structure of the census and whether provincial supervisors are permanent or temporary employees. If they are permanent employees, they will generally have support such as office facilities and personnel to assist them in managing communication with their deputies. In the case they are temporary employees, the ratio with deputies will depend on whether they are office or home based and how much of their role involves direct contact with deputies or lower staff. The **deputy provincial supervisor/supervisor ratio** also takes into account available time but focuses more on administrative and management role of the two levels in the overall structure. **Supervisor/enumerator ratio** is especially important. The number of enumerators reporting to each supervisor has a direct bearing on the amount of time a supervisor may spend with each enumerator in training and in the field. It will also impact on the amount of quality assurance that can be performed on the work of enumerators before the census forms are returned for processing. Establishing the ratio cannot be done by formula and will involve some level of qualitative rather than objective judgement. The opportunity of field tests including pilot census should be used to confirm the feasibility of the general supervisor/enumerator ratio. The most used number is five to ten enumerators per supervisor.

Some elements are to be taken into account while estimating the number of enumerators to be recruited such as: statistical units in the frame, the average time for filling in a questionnaire, number of questionnaires to be filled in a day.

Example of estimating the number of enumerators to be recruited

100.000 units to survey

Estimation of 1 hours to complete the interview

Estimation of 5 questionnaires to be filled in a day

You may need: 500 enumerators for 40 working days or 250 enumerators for 80 working days

Warning: you may save money, reducing the number of enumerators but increasing the time for data collection.

15.23 Enumerators and supervisors should be recruited and trained locally. Experience shows that sending the enumerators from the capital city or from other regions to a region which they are not familiar with, may compromise the result of the census and should be avoided. It is essential, therefore, that detailed and clear instructions are given to these field staff in written form. Some suggestions in this respect are given below:

◆ **Administrative and financial aspects.** Administrative aspects are of vital importance for the census officers because they are closely related to the remuneration they will receive. Such details as how salaries and subsistence allowances are paid, description of the administrative forms which have to be completed, etc., should be in writing, possibly as an annex to the Instruction Manual (see Chapter 14). The place to make sure that enumerators and supervisors learn their duties, responsibilities and rights is at the training courses (see Chapter 16). Problems may arise from staff who did not understand the instructions properly and who do not receive their wages punctually, and these kinds of problems can have an adverse effect on the census work. Two main aspects are to be considered in order to address the remuneration problem, the way to pay the field staff and the forms of payment. Countries can either set wages rates regardless of the output produced by the individual or a variable payment based on the number of questionnaires and their quality cleared (e.g 1\$ per questionnaire cleared). In other cases a combination of these two forms of payment are adopted: a fix amount plus a variable payment based on their productivity of the work and its quality.

Another issue in countries where banking network is not extended in some areas is the modalities of providing payment to field personnel in time. This issue has proven to be of critical importance in some countries causing delays in field work. From the initial stages of planning the census, adequate solution should be found to this issue. There is now a growing use of electronic money transfer modalities that may be considered. However, many management systems require that individual contracts are signed with staff receiving payment and that signed returns are received prior to next payment. Census management should discuss and adapt effective solutions suitable for country conditions.

The work schedule should be specified; it may be very flexible but will normally involve working evenings, week-ends and holidays, and should describe the frequency of communication with senior staff. It is not advisable to call supervisory staff to the provincial office frequently or to meetings at other places called by senior staff, as it will detract from their supervisory activities; it is preferable to meet these staff in the field as a part of their supervision or having some type of phone/email communication as explained above.

(Cambodia example of the ways of payments)

◆ **Period of work.** The period of work for which each type of staff is hired should be carefully planned and fixed in advance, since many problems arise when officers contemplate the possibility of the work period being extended and receiving extra remuneration. When they see the possibility of extra remuneration they may tend to work slower at the outset and then, realizing that there will be no extension, speed up too much and neglect the quality of the work. It is therefore very important that the duration of the contract be fixed in a realistic manner which can be strictly observed, and that it is stated quite clearly that the fixed periods have to be respected in order to meet work plan and budget restrictions. Continual feedback on quality and quantity of work should be considered as a condition of employment.

◆ **Recruitment of enumerators.** Instructions for the selection of enumerators should be detailed, starting with the basic qualifications and experience required, although it should be recognized that some judgement must be left to the supervisor. The final selection and hiring of the staff will be less subjective if made principally by means of an examination based on a model prepared in the central office. The supervisor must be provided with a list of agencies which can be approached for recruiting staff and the requirements which the candidates must meet, as well as a warning of physical limiting characteristics that could limit the use of a person as an enumerator. Previous census employees who have received a good recommendation should be considered as well. When using outsourcing staff, contracts, insurance, and other legal aspects must be taken into account and make it as clear as possible.

Conducting the census using the modular approach or integrated census/survey modality will have implication on the recruitment process of enumerators which could be done in several stages. The enumerators for supplementary modules need to have greater qualifications and special training in comparison with enumerators for the core module and their number is usually less than that needed for the core modules. Thus, the best qualified enumerators of the core module could be trained to act as enumerators in the supplementary modules.

Box 15.1 Country examples on field staff recruitment procedures

Some examples of country practices in recruitment procedures comprise the case of **Uganda** following a top to bottom procedure where Chiefs Administrative Officers (CAOs) were asked to identify senior officers at district level as potential District Census Supervisors following educational profile for the candidates. About 130 District Supervisors were in such way identified and they had to recruit suitable qualified persons who would be trained and deployed as Enumerators. The characteristics of recruited persons refer to age, educational attainment, proximity to the group of EAs to work in, proficiency in the dialect spoken by the potential respondents, and, suitable character of the candidate. An official communication was sent to each CAO and copied to the District Production Coordinator (DPC), in which the two district officials were entrusted with the task of advertising the posts, interviewing the candidates and identifying the most qualified ones for training and appointment. A total of 936 Enumerators were recruited for the UCA countrywide.” In other cases like in the 2007 **St Lucia** Census of Agriculture, the selection procedure also comprised a quiz delivered after the training course for enumerators. Based on the answers to the quiz some potential enumerators would not be recruited.

Link to Uganda Agricultural Census on recruitment process

Link to Quiz delivered after the training course for enumerators. Based on the answers to the quiz some potential enumerators would not be recruited. (Taken from St Lucia Agricultural Census 2007).

Enumerators

15.24 The census enumerators form the bulk of the census field staff, being responsible for data collection, the sending of completed census questionnaires and the final revision of questionnaires returned by the supervisor. The requirements that enumerators have to fulfil can be roughly categorized into three groups: (i) educational requirements, (ii) abilities and skills, and (iii) personal characteristics. These requirements are listed in **Table 15.2**.

15.25 The enumerators work under the control of the local supervisor. Field enumerators are key persons to the success of the agricultural census, because finding respondents and making a proper recording of each agricultural holding's structure depends largely on them. Therefore, it is extremely important that the enumerator pays careful attention and fully understands his/her responsibilities/duties in preparation for the agricultural census and in the field. The enumerators must be enthusiastic about the value and importance of the census for national development. They must set about their responsibilities/tasks with a high sense of purpose in order to overcome holders' prejudices and suspicions and do so in such a manner that the holders gain confidence and provide correct information. Enumerators should be able to explain to people the real objectives of the census and how, by providing the facts about agriculture, the holders would be helping in the formulation of development plans and policies beneficial to themselves, community and to the nation at large.

15.26 The work of enumerators will usually involve a mixture of: contact with respondents, which will involve representing the statistical agency to respondents, answering queries about the census and providing assistance; clerical work at home and in the field which will involve understanding and applying procedure and guidelines; and travel to and from, and around the enumeration area. The specific duties/responsibilities/tasks of enumerators can be broadly classified into three categories: (i) pre-census enumeration responsibilities/duties, (ii) during census enumeration responsibilities/duties or core tasks and (iii) post-enumeration responsibilities/duties. These responsibilities/duties are listed in **Table 15.1**.

15.27 The enumerators should be persons familiar with local agricultural and social conditions and be residents in the local areas, if possible, so that they can easily converse with the respondents in the local language/dialect. Ideally, the enumerators should have the minimum of a high school education and preferably have some knowledge of or have studied agriculture. Holders' family members are often potentially good enumerators. Village teachers (during holidays) and agricultural extension workers are usually good field enumerators. Population census enumerators, if such a census has been conducted recently, can be recruited. Permanently employed enumerators are more common in countries using time-consuming objective measurements of crop areas and yields requiring repeated visits. The workload of enumerators should be carefully assessed in order to avoid large work assignments in a short time frame which could result in poor quality data.

15.28 In difficult areas with poor communication and transport facilities, special attention should be given to recruiting enumerators within those areas. Tribal and nomadic householders should be approached tactfully. This group of households require special consideration. The census enumeration is a

strenuous job. It is, therefore, desirable to ensure that the conditions of employment as well as the performance objectives are well understood by the enumerators. .

15.29 In case the census is planned to be conducted using the modular approach and the enumerators are supposed to select the holdings for sample enumeration, then they must have sufficient background to be successfully trained in the random selection process. In case the sample is selected in the central/regional office and the enumerators are just given the lists of holdings to be enumerated, then this aspect is not so important.

Supervisors

15.30 The supervision is important to allow for correction of errors and making necessary adjustments in course of the field work (see Chapter 7). Close monitoring during the enumeration phase is essential to ensure coverage, quality and compliance with the deadlines. Supervisors have to fulfil a number of requirements that can be categorised as: (i) educational requirements, (ii) abilities and skills, and (iii) personal characteristics. (See **Table 15.2**).

15.31 The enumerator's work is monitored by local supervisors who control the work and provide technical guidance, and who, in turn, are monitored by provincial supervisors. Supervision of the enumerator's work is an essential requirement for the success of any census.

15.32 Supervision helps prevent carelessness and permits the early detection of errors that can be corrected while the enumeration is still in progress. Supervisors need to keep records regarding the progress of enumeration and take appropriate action whenever the work is inadequate and not performed in accordance with a predetermined time schedule. They must encourage enumerators to perform satisfactory work. Attention should be given to the number of supervisors hired. In countries where they have to cover large distances and have additional duties such as the preparation of the summary of results and/or calculation of areas based on measurements, etc. the number of supervisors should be higher.

15.33 Experience shows that supervisors should work with the enumerators through training and the start of the enumeration and be present at several early interviews with each enumerator. They could then detect deficiencies and take immediate remedial action. When the enumerators have completed one phase of their work in a locality, the supervisor reviews their questionnaires and asks them to rectify any deficient work.

15.34 Supervisors need to give special attention to checking the accuracy of the boundaries of the enumeration area. They have to travel into these areas to ensure that the administrative borders are the same as those given to them. These visits will help them in allocating enumerators to various districts and suggesting any needed variations in the publicity, financial and/or administrative work. The responsibilities/duties of supervisors are shown in detail in **Table 15.1**.

15.35 Supervisors should have similar qualifications to those of enumerators but with a higher level of education and some administrative experience as well as previous census experience. Experienced enumerators often make good supervisors. In particular, the enumerators that had been used for listing operations could be future supervisors. Supervision and the enumerators' work of the agricultural census is considered to be more difficult than that of the population census because the questionnaire is more complex and the work is mainly focused in rural areas. Supervisors need to have knowledge of local conditions, customs, travel problems, language, dialects, etc. A team of senior officers engaged in the

census should interview supervisory candidates, testing and screening them for specific qualities. The provincial supervisors are responsible for all technical and administrative matters in the province and must therefore be experienced officers with sound technical knowledge of agriculture and of census work and a proper understanding of the census plan. If handheld devices are used, supervisors should also ensure the safety and security of the equipment, electronic assignments of workload, liaising with IT personnel on trouble shooting technology issues and ensuring the maps are reflecting accurately the holdings and boundaries in the field.

15.36 If the census is conducted using the modular approach, the supervisors may be involved in the selection process of the sampled holdings. In such case their background must be sufficient for understanding the random selection process. In case the sample is selected in the central/regional office and the enumerators are just given the lists of holdings to be enumerated, then this aspect is not so important.

DRAFT

Table 15. 1. Responsibilities and work assignments of main field staff

	Supervisors	Enumerators
Pre-enumeration responsibilities/duties	<ul style="list-style-type: none"> • Attend the training of supervisors’ workshop 	<ul style="list-style-type: none"> • Attend the training of enumerators’ workshop
	<ul style="list-style-type: none"> • Select, recruit and train (testing) the enumerators 	<ul style="list-style-type: none"> • Receive field enumeration kit and tools from supervisor (enumeration material and equipment)
	<ul style="list-style-type: none"> • Prepare mapping, listing and other census field material 	<ul style="list-style-type: none"> • Develop an enumeration schedule/itinerary
	<ul style="list-style-type: none"> • Become familiar with the EAs under his(her) responsibility 	<ul style="list-style-type: none"> • Become familiar with the EA and the household/holding that he has been assigned to interview
	<ul style="list-style-type: none"> • Distribute assignments and enumeration kit and tools to each enumerator under his/her supervision 	
During enumeration responsibilities/duties (core tasks)	<ul style="list-style-type: none"> • Conduct day-to-day supervision of a team of enumerators and provide performance feedback to them 	<ul style="list-style-type: none"> • Explain to holders or community groups the purpose of the Agricultural Census, why they should provide census data according to the questionnaire and the importance of providing complete and accurate data.
	<ul style="list-style-type: none"> • Supervise and provide on-the-job training (OJT) to several enumerators within the Supervisory Area (SA) 	<ul style="list-style-type: none"> • Represent the census authority to respondents and explain the objectives of census and their procedures to people who will be interviewed
	<ul style="list-style-type: none"> • Provide enumerators with a phone number and e-mail address or any other method for quick communication. 	<ul style="list-style-type: none"> • Listing holdings/households units and register the address and the particulars for each agricultural holding and household in their assigned enumeration area(EA)or updating the lists already produced before the enumeration phase is done.
	<ul style="list-style-type: none"> • Visit enumerators in the field during the data collection process and after the enumeration is completed 	<ul style="list-style-type: none"> • Contact people through the method adopted by the country (in person, mail, telephone etc.) for completing the questionnaire to obtain pertinent data for each agricultural holding/household unit
	<ul style="list-style-type: none"> • Prioritize, coordinate and monitor the work flow and ensure that all procedure are being followed according to the instructions provided by census authority 	<ul style="list-style-type: none"> • Travel to and from their assigned enumeration area(EA)
	<ul style="list-style-type: none"> • Report to management on issues affecting data quality and any other issues they should be aware of 	<ul style="list-style-type: none"> • Provide assistance to respondents for reading forms (either in paper or on the screen) and answering questions about the census
	<ul style="list-style-type: none"> • Conduct an intermediate review of questionnaires, visitation records and maps for completeness and accuracy 	<ul style="list-style-type: none"> • Clerical work at home and in the field
	<ul style="list-style-type: none"> • Visit and interview agricultural holdings who refused to cooperate with an enumerator, or assign these agricultural holdings to other enumerators 	<ul style="list-style-type: none"> • Update and correct their assigned Enumeration Areas maps and addresses, as required, in coordination with supervisors
	<ul style="list-style-type: none"> • Provide assistance with Enumeration Districts that enumerators were unable to complete due to difficult and unusual circumstances. 	<ul style="list-style-type: none"> • Double check information on census forms to ensure the accuracy of information. If a handheld device is used, the accuracy of the answer before entering the data and follow the instructions of automatic consistency checking procedures incorporated in the CAPI system, has to be ensured
	<ul style="list-style-type: none"> • Reassign Enumeration Districts that require more work to be completed or corrected to other enumerators. 	<ul style="list-style-type: none"> • Ensure full coverage of all enumeration units within assigned EA.
	<ul style="list-style-type: none"> • Periodically report on the progress of interviewing in the Supervisory Area and turn in the completed 	<ul style="list-style-type: none"> • Report to supervisor on issues affecting data quality/census enumeration.

	Supervisors	Enumerators
	work to the corresponding Census Supervisors Coordinator (Provincial Supervisor)	
Post-enumeration responsibilities/duties	<ul style="list-style-type: none"> Conduct a formal check of each enumerator's work at the end of the enumeration process 	Report to the supervisor all collected census forms/information, as well as documentation and expenses encountered. If using handheld devices, send completed forms electronically to the supervisor following the agreed modality.
	<ul style="list-style-type: none"> Conduct visits to a sample of randomly selected agricultural holdings. 	<ul style="list-style-type: none"> Complete their visitation records (VRs) and ensure all questionnaires are accounted for
	<ul style="list-style-type: none"> Write a field report 	<ul style="list-style-type: none"> Hand over all questionnaires (filled, spoilt and blank) or return the PDA with other material used in the census to the supervisor
		<ul style="list-style-type: none"> Write a brief field report

Table 15.2. Requirements of main field staff

	Supervisors	Enumerators
Educational requirements	Education - Ideally, have bachelor education and preferably some knowledge of agriculture	Education - Ideally, have high school education and preferably some knowledge of agriculture
	Administration and Management - Knowledge of principles involved in strategic planning, resource allocation, leadership, and management of people and resources	IT knowledge - Knowledge of computer hardware and software, including applications and programming, especially if data entry is done through CAPI
	Clerical - Knowledge of administrative and clerical procedures (word processing, files and records, writing figures, typing, etc.)	Clerical - Knowledge of administrative and clerical procedures (word processing, files and records, writing figures, typing, etc)
	Language skills - Knowledge of the structure and content of the country/local language	Language skills - Knowledge of the structure and content of the country/local language
	Geography - Knowledge of principles and methods for describing the features of land, sea, where appropriate, and air masses, including characteristics, locations, and distribution of plants, animals, and people	Geography - Knowledge of principles and methods for describing the features of land, sea, and air masses, including characteristics, locations, and distribution of plants, animals, and people
	Education and Training - Familiarity of methods for training design, teaching and instruction for individuals and groups	Cartography - Able to read and understand maps and cartography
	Mathematics - Knowledge and use of arithmetic	Mathematics – Knowledge and use of arithmetic
	Personnel and Human Resources - Understanding of procedures for personnel recruitment, selection, compensation, labor relations and negotiation.	
	Experience - Experience in supervisory and conducting censuses and/or surveys	
	Expertise - In-depth knowledge of censuses and/or surveys procedures and manuals	
	Methods - Knowledge of census/survey methods and terminology	
	Cartography - Able to read and understand maps and cartography	

	Supervisors	Enumerators
Abilities and skills	Management of Personnel - Motivating, developing, and directing people as they work.	Customer Service -Customer needs assessment, meeting quality standards and evaluation of satisfaction
	Organizing, Planning, and Prioritizing Work - Developing specific goals and plans to prioritize, organize, and accomplish the work.	Time Management - Effective management of own and others' time
	Social Skills - Customer and personal service, leadership and team interaction skills	Accuracy – Record information on questionnaires accurately
	Quality Control Analysis - Conducting tests and inspections of products or processes to evaluate their quality or performance	Written and Reading Comprehension - Ability to read and understand written information
	Communication - Ability to communicate effectively both verbally and in writing	Communication – Ability to communicate effectively both verbally and in writing
Personal characteristics	Monitoring - Monitoring/Assessing performance of him/herself, other individuals, or organizations to make improvements	Active Listener - Give full attention to what other people are saying, understand the points being made, ask appropriate questions, and not interrupt at inappropriate times
	Critical Thinking and Problem Solving - Using logic and reasoning to identify solutions, conclusions or approaches to problems	Social sensitivity - Be familiar and have sympathy with local and social conditions
	Coordination – Capacity to organize individuals or groups for them to work together efficiently.	Reliable - Persons who, by their attitude and behavior, obtain other’s respect and confidence
	Instructing - Teaching others how to do or perform certain tasks	

Suggested reading

- ◆ UNSD, 2015. Handbook on Census Management for Population and Housing Censuses. New York. Rev 2.
- ◆ UN 2015. Principle and Recommendations for Population and Housing Censuses: the 2020 Round, Revision 3 New York. <https://unstats.un.org/unsd/statcom/doc15/BG-Censuses.pdf>

CHAPTER 16 TRAINING

The census of agriculture involves hundreds or thousands of personnel with different roles, levels and capabilities (Chapter 15). All staff needs to be trained in a short period. Therefore, training of census personnel faces important challenges: diversity of training courses addressed to staff with different profiles; establishment of training venues all around the country; uniform delivery of training in all venues; selection of appropriate training techniques and/or training aids; assessment of trainees, etc.

The contribution that a well-planned and executed training programme can make to the quality of the census results therefore cannot be stressed strongly enough. Such a training programme must focus on the widely dispersed and difficult to supervise field staff (namely, the enumerators and their immediate supervisors) but it must also cover others (the higher-level supervisors, editors, coders, computer operators).

This section discusses training activities required for census taking. It is subdivided in sub-sections according to the type of staff: training of trainers, training of enumerators, training of supervisors and training of office staff. The section also deals with the training in the use of new technologies as well as the use of training aids.

Main related topics to the one treated in this section are: Instruction Manuals (Chapter 14); Staffing (Chapter 15); Organization of field work (Chapter 17).

Organization and logistic of the training programme

16.1 The entire census training programme should be designed to cover each phase of the work according to the census approach and provide an efficient and consistent means of effectively preparing large numbers of employees for their work. The programme will need to correspond closely to the needs of the various operations and, where appropriate, may include both theoretical and practical instruction, with emphasis on the latter.

16.2 Because of the importance, the complexity and the short time schedule to follow, the training programme needs to be strictly planned by staff having the necessary qualifications and experience in capacity building for large and heterogeneous groups of personnel. The organization and delivery of training courses should be included in the planning and budgeting stages of census preparation.

16.3 Great care has to be exercised in ensuring that content and timing of training programmes are appropriate for the level of personnel expected to be trained. Attention should also be given to developing proper training material for the training classes. If a census has been conducted in the past, the contents of the training materials may be up-dated by using the experiences of the previous census. In countries with more harmonized the systems, platforms, tools, concepts, procedures among the entire suite of census and survey programs, it is easier to move staff from one program to another. By working this way, the training will be easier. Accommodation for training classes for trainees, and the supply of blackboards, projectors and other requisites for holding a class as well as kits such as notebooks, pencils and erasers, have to be provided to ensure a successful training programme. Training needs can be partly covered by existing educational facilities available in each country (viz., training in data processing, sampling, etc.). An important part of training has to be organized as part of the census preparation (viz., training of enumerators, supervisors and their trainers).

16.4 The ways to deliver the training at different levels need to be carefully planned in the training programme because such ways imply different costs, special qualifications of trainers and in some cases (for example use of e-learning) a completely different logistics.

16.5 The organization and conduct of training courses should be entrusted to those having the necessary qualifications to carry out this task successfully, taking into account not only their professional abilities but also their ability in teaching. This means that staff in charge of training should have certain qualifications that will enable them to stimulate the interest of trainees and to transfer the required knowledge, since otherwise well-qualified technical personnel who are unable to transfer their knowledge to the trainees in a satisfactory manner will be unsuitable as instructors for group training activities. This must be taken into consideration when selecting instructors and it is recommended that objective criteria should be used. In practice, however, it is difficult to find the necessary number of instructors who have both the professional and the teaching qualifications; for this reason, the instructors selected should themselves undergo training in how to organize and conduct training courses. This is known as “training of trainers”.

16.6 The base of the census organization is the field work to be performed by a large number of census enumerators. These enumerators are supervised by field supervisors who in turn are supervised by provincial coordinators and so on, up to the peak of the pyramid: the main technical staff at the central census office (Chapter 15). The training procedures can be seen from up to down in a “cascade” manner:

- ◆ in first place, high-level census organizers responsible for census organization and administration;
- ◆ main technical staff at the central census office is charged with the training of trainers for different type of tasks (training for census enumeration and supervision, training of office staff (programmers, coders, data-entry operators or operators of data recording equipment, cartographers); training for using advanced technologies;
- ◆ the staff so trained will deliver the training courses down to provincial coordinators and office staff;
- ◆ provincial coordinators so trained have to deliver the training to field supervisors;
- ◆ field supervisors must train the field enumerators.

16.7 In the case of the enumerators and their immediate supervisors, the training is most effective if it includes several opportunities for the trainees to participate in practical interviews and role-playing exercises, including in the use of adopted IT solutions. In countries in which multiple languages are used, the method and content of the enumerator training programme will need to be suitably adjusted. For example, if the questionnaire is printed in another language, provision will have to be made for instructing enumerators on the correct formulation of the census questions in the local language.

16.8 The training programme for coders, editors, data-entry operators, operators of data recording equipment and so forth should also provide opportunities for the trainees to practice under the supervision of the trainers, the operations it is expected they will subsequently perform. The intermediate and higher-level technical staff, such as programmers and system analysts, may also benefit from special training programmes. For them, the emphasis should usually be on recent technical developments of relevance to the forthcoming census and on the interrelationships among the various aspects of census plans and operations.

16.9 It is important that each training programme be made available in manuals (booklets) form and distributed to the census organizers and training instructors. Such manuals would be a valuable guide and would help considerably in the efficient training of census staff. It would also contribute to the

uniformity of training, which is an essential factor for a successful enumeration, taking into account the great number of census instructors who will be engaged in training (Chapter 14). Simple audio-visual aids (for example, film strips, posters, tape recordings, slides) can also be used to help make the training more effective and uniform throughout the country. If available, new multi-media technologies can facilitate the provision of training at distant locations (distant learning) and be effective and efficient supplementary tools for training. Some countries have developed an e-learning platform where the enumerators could do self-training and tests, which is particularly useful when enumerators have to be replaced during the field work phase by new enumerators.

16.10 The organisation of the training programme must carefully consider the time required to train staff at different levels and for the various aspects of the census. This depends on several factors:

- ◆ the type of function for which they are being trained, the level at which they will be performing, the census methodology or modality, the complexity of the census, the educational level of the trainees, the number of instructors available and the resources available.
- ◆ Usually, all courses last from one week to one month. It is strongly recommended that the training be carried out daily for a fixed period. The results are not as good if training is provided for a few days per week, since with this approach, which draws out the length of the course, previous work is often forgotten and has to be repeated (see also paragraph xx).
- ◆ It is best to avoid completion of the training long before the start of the actual work. Any duration, however, may be fixed for the course, provided that the main principle—namely that training should be long enough to permit the assimilation of the syllabus—is not overlooked.

16.11 It is important to consider that some of the personnel would belong to the census organization while others - mainly enumerators and immediate supervisors - are either recruited for this purpose or taken on loan from another organization for the period of census enumeration. Different types of training programmes should be developed so that the training given be appropriate to the level of the task the trainee is expected to perform during the census operation.

16.12 Actual contents of the training package for census staff will vary from country to country, depending on the census modality and status and development of agriculture. The broad areas on which emphasis in training should be made are as follows:

- ◆ Training should be both theoretical and practical. Experience shows that practical training in simulated census situations is important in helping the trainees understand the theoretical aspect and in preparing them in advance for various problems and complications which may arise during their work. Group discussions are also useful.
- ◆ The training should be centralized if possible, since this provides unified training on one subject from one instructor. This could be done for census staff and provincial supervisors on a national basis, while field supervisors and enumerators are trained at the provincial level.
- ◆ Training should be directed at the work and responsibility of each group. Supervisors are to be trained by those who designed the census, and enumerators by supervisors who have already been trained.
- ◆ Census personnel should be screened and a final selection made on the basis of a written examination plus an interview at the end of training to ensure they are qualified to do the work.
- ◆ Training should instil the serious nature of the work and ensure positive participation during the training course.
- ◆ Training should be carefully organized and outlined with an appropriate agenda and time schedule.

- ◆ The training staff should meet after each training session to discuss the days' work and evaluate trainees according to their participation, and to discuss the next day's programme. Trainers should also identify any areas where training material needs to be clarified or more training examples need to be presented.

Training of trainers

16.13 The number of census staff depends on the characteristics of the country. In some cases only a few technical staff will be involved in cartographic or computational programming whilst in other countries a large amount of staff is needed for those tasks. In case of a small number of personnel needed for a specific task (less than 30, say) they may be trained directly by the central office staff or specialized instructors contracted specifically for conducting the training courses. When the number of staff to be trained is large trainers involved need to be previously trained.

16.14 Training of the senior census staff, such as census organizers and subject matter specialists (data processing, sampling, etc.) lacking knowledge and experience in census applications represents a problem as highly specialized training is not normally available in many countries. Senior census staff in countries with long census traditions receives on-the-job training. For countries with little or no tradition in census taking, international training should be organized, such as study tours in neighbouring countries.

16.15 Training may have to be organized at international centres for senior staff, at national training centres for middle-level executives and at various places within the country for enumerators and supervisors. Training for supervisors from the census organization who would mainly become trainers of enumerators might have to be organized in a different manner than training of supervisors taken on loan for the period of enumeration.

16.16 The requirements for training an adequate number of professional staff, particularly at advanced levels, and of agricultural census staff and data processing experts, should be considered well in advance of training. Countries requiring external assistance have to take necessary action to include such requirements in their programmes for technical assistance well ahead of the commencement of work on plans for their agricultural census.

16.17 Technical staff from the main census office will train the supervisors both as trainers for enumerators and specifically for their supervisory tasks (see Chapter 16).

16.18 Persons trained at national training centres are likely to become very important in the census taking, and the success of the census operation will depend on the quality of their work and the enthusiasm they can generate among their co-workers and field staff. Their training should not only cover the enumeration work, but also cover the broader aspects of the agricultural census. These trained personnel can train enumerators and supervisors in census work and, subsequently, supervise their work. It would be desirable to include in the training plan the experience of past censuses and the use made of the data collected. Documented material of the previous census may include lessons learnt related to the training. Information regarding agricultural censuses carried out in other countries may also be useful training material particularly for countries not having census experience. Training should also cover the preparation and use of cartographic maps and GIS.

16.19 The number of enumerators in the agricultural census may be quite large, particularly in a large country organizing a complete enumeration census. In China, around 700,000 enumerators were recruited

in 2007 while in Brazil 80,000 enumerators and supervisors were engaged in the 2006 census. It is clear that all these people cannot be trained at one centre and that many levels of training should be envisaged. Such training could be organized at a provincial level with a number of training centres established throughout local areas. Training should be unified and given at the same level by employing master trainers who could be trained in a central provincial office. Those engaged in training at these centres could be instructed originally at the master training centre. The master trainers could be selected from the headquarters' supervisory staff.

Country examples-Links

Training of supervisors

16.20 Special emphasis should be given to the instructions for and training of supervisors. In view of the importance of the role of supervisors, they should have an intensive training programme. Normally, the field supervisory staff would be trained first by the technical officers of the executive agency responsible for the agricultural census. The supervisors will, in turn, train the enumerators or at least participate in the training. The training of the supervisory staff should also include items concerning the training of enumerators, and they themselves should be trained to become good enumerators. The supervisory staff should also be trained in the procedures for selection of enumerators (if they are given this task), publicity, preparation of field work reports, etc. They should be given actual practice in the methods of training enumerators and in checking enumerators' field work.

16.21 Contents of training courses for supervisors must strictly follow the contents of the supervisors' manual. In Chapter 14 above, it is explained that the following points should be included in the supervisors' manual and, therefore should be the guidelines for structuring the training courses for supervisors (See Chapter 14):

- ◆ General responsibilities of the supervisor
- ◆ Selection, recruitment and training of enumerators.
- ◆ Preparation of mapping, listing and other census field materials.
- ◆ Field supervision, checking, editing and progress report. If CAPI is used, detailed explanation on how to proceed with electronic questionnaires received, their checking and edition and the way the supervisor return his/her feedback to enumerators.
- ◆ Preparation of summary of most important data (when envisaged).

Based on such broad issues, it is suggested that the following subjects may be considered for inclusion in their training programme in addition to the subjects for enumerators:

- ◆ **Supervisors' work**
 - Their responsibility
 - How to check maps of local areas and enumeration districts
 - Preparation of lists of holders and how they are used and checked, using training guides.
- ◆ **Work dealing with enumerators**
 - Action required to select and recruit enumerators
 - How to conduct training sessions for enumerators
 - How to monitor the enumerator at work
 - How to review and edit questionnaires and other records prepared by the enumerators
 - How to measure the performance of enumerators
 - How to handle cases of respondent refusal to provide required information

- How to handle special problems encountered by enumerators
- How to replace enumerators
- How to do a final review of enumerators' work.
- ◆ **Field work**
 - Practical training in data collection and filling-in questionnaires
 - Organization of field editing and aggregation of completed questionnaires.
- ◆ **Quality control (if assigned)**
 - Procedures
 - Reporting
- ◆ **Technical matters**
 - Reading maps, identifying parcels
 - Estimating fractional areas of parcels
 - Identifying important crops
 - Local units used and their conversion to standard units of measure.
- ◆ **Other matters**
 - Publicity
 - Data processing.
- ◆ **Administrative instructions**
 - Hours of work
 - Absenteeism
 - Administrative authority and responsibility
 - Required attendance records
 - Action to be taken when work is not satisfactorily completed.

Training of enumerators

16.22 Instructions for and training of enumerators are most important because the quality of the census results depends primarily on enumerators. The instructions for enumerators, should be contained in well-prepared manuals written in simple local languages (see Chapter 14). These manuals serve both as an instructional text and as a reference guide during enumeration. They can be presented in different ways: printed manuals, on-line manuals or manuals included in the software of data capture devices or any combination of them. They have to be complete and offer guidance on all major and frequently encountered problems. Manuals should take into account prior training and knowledge acquired by personnel in previous work. Preparation of these manuals is a priority, and should be undertaken by persons with a thorough knowledge and experience in the subject matter, the design of the census, and the psychology of both data collection personnel and holders. In the case of multi-language countries, alike the questionnaires, such manuals should be prepared in each of the local languages.

16.23 An important aim of enumerator training is to develop enumerators' capacity to motivate respondents to give complete and accurate answers. The training should also equip the enumerators with the knowledge and skills for doing their job well, since the census is an inquiry of a special technical nature. The enumerators should have certain qualifications, including some knowledge of agriculture is desirable. The training should be oriented to prepare the enumerators to:

- ◆ Be conversant with the legal provisions of the census and know their own rights and responsibilities.

- ◆ Approach the respondents with a sympathetic and persuasive attitude and not as an official intending to force information from the respondent. This can be accomplished through training the enumerators not only in the concepts and technical aspects of the census, but also in the art of approaching the holders properly and winning their confidence. The enumerators should be able to check data given to them by holders without offending them and appearing to doubt their word. Some enumerators will have prior experience on how to interview a holder, because they are extension workers or rural teachers, or have another occupation which brings them into contact with holders. In other cases, the enumerators will not have this experience and this part of the training is essential. The enumerators should be trained to avoid the temptation to guess possible answers to some of the questions with which the respondent may be having difficulty. The training of enumerators should include some days devoted to field work. This field work training should require the enumerators to collect data from not less than five agricultural holders. In addition, pre-prepared pre-filled questionnaires containing typical errors and problems could be prepared for them to edit and review in class.
- ◆ If handheld devices are to be used in census data collection, the enumerators need a special training in the use of the devices, interpretation of prompts, messages and warnings and ways for sending complete questionnaires to their supervisors. A special training with actual determination of coordinates and area measures in the field (if required) is also needed for using GPS devices (either built-in in the handheld device or a separate GPS). At least two training sessions should be devoted to the use of handheld devices.
- ◆ Read maps, GIS maps on screen, prepare usable sketches, and identify individual parcels and determine their areas, if required.
- ◆ Be able to estimate, if necessary, the number of scattered trees, distinguish between trees of bearing and non-bearing ages, and identify important crops.

16.24 Be able to measure the areas of parcels and crop yields using instruments if objective measurements are adopted as a method of data collection.

16.25 The length of training will depend on many factors, such as literacy of respondents, previous knowledge and experience of enumerators, content and design of questionnaires, or whether objective measurements are used. Generally, in developed countries, training of just a few days may suffice. In developing countries **8-10 days** may be appropriate and even 12-15 days if objective measurements are used. The training of enumerators should be undertaken as close as possible to the starting day of the field work when the knowledge and skills are still fresh in their minds.

16.26 Contents of training courses for enumerators must strictly follow the contents of the enumerators' manual. In Chapter 14 above, it is explained that the following points should be included in the enumerators' manual and, therefore should be the guidelines for structuring the training courses for enumerators (see Chapter 17):

- Census operation;
- Objectives and nature of the census;
- Organization responsible for the census;
- Legal aspects and confidentiality;
- Obligation and rights;
- Map-making and reading;
- Use of GPS;
- Use of data-capture handheld devices.

Based on such broad issues, it is suggested that the training of enumerators follow these lines:

- ◆ **Background information**
 - Information regarding agricultural conditions prevailing in the country
 - What an agricultural census is; why it is taken; its importance and use.
- ◆ **General information for the enumerators**
 - The tasks
 - Their responsibility
 - Their place in the census organization
 - Their relations with the respondents
 - The Census Legislation
 - Confidentiality of information collected.
- ◆ **Objectives and nature of the census**
 - What information is to be collected
 - How the census is organized
 - How the census is to be taken
 - When sampling is being used, how the sample is selected.
- ◆ **The prescribed questionnaires and listing schedules**
 - Concepts and definitions that are used
 - Making entries on electronic or paper-based questionnaires
 - Example of questionnaires already completed.
- ◆ **Procedures to be followed (see also Chapter 16 and Chapter 18)**
 - Making appointments
 - From whom to obtain information
 - Techniques for conducting a good interview
 - Overcoming objections of holders to provide information
 - How to deal with difficult respondents, an environment with potential safety issues and appropriate actions.
 - Objective measurements (if any)
 - Checking and editing questionnaires
 - Call back to obtain missing information
 - Ensure completion of coverage
 - Use of interpreters.
- ◆ **Practical work**
 - Visit an area in the neighbourhood
 - Distribution of work among the enumerators
 - Explaining their work to enumerators
 - Actual completion of some questionnaires and reports by the enumerators (see paragraphs xx-xx)
 - Measurement of areas and yields (if envisaged).
- ◆ **Editing**
 - Discussion of filled-in questionnaires
 - Explanation of concepts and definitions in light of experience in the field

- Explanation of job requirements of the enumerator
- Explanation of procedures to be followed in enumeration.

◆ **Examination**

- Quiz on the questionnaires
- Quiz on procedures.

◆ **Administrative instructions for enumerators**

- Hours of work; the need to conduct interviews outside normal office hours
- Absenteeism
- Allowances that would be paid and conditions attached to payment
- Enumerator requirements on administrative matters
- Required records on time and attendance

Forms to be filled on completion of work.

DRAFT

Box 16.1. Example of Quiz for enumerators after the training course (taken from St Lucia Agricultural Census 2007)

QUIZ

1. Please, read the following passage:

An agricultural holding (or farm) is an economic unit of agricultural production under single management comprising all land used and livestock kept wholly or partly for agricultural production purposes, without regard to title, legal form or size. The holding's land may consist of one or more parcels, located on one or more Administrative Districts, providing the parcels share the same production means utilized by the holding, such as labor, farm buildings, machinery or draught animals (the requirement of sharing the same production means should be fulfilled to a degree to justify the consideration of various parcels as components of one economic unit.)

For each of the following statements referred to in the above passage, please circle T if it is TRUE or F if it is FALSE:

- | | |
|---|-----|
| 1. An agricultural holding always consists of one parcel of land | T F |
| 2. An agricultural holding is an economic unit organized to produce agricultural products under a single management: | T F |
| 3. An agricultural holding always has more than one parcel: | T F |
| 4. All the parcels of one agricultural holding must be in the same Administrative District: | T F |
| 5. There are agricultural holdings without land: | T F |
| 6. There are agricultural holdings without livestock: | T F |
| 7. An agricultural holding can have part of its land with agriculture and part of it with residential buildings: | T F |
| 8. If different parcels do not share the same production means they belong to different agricultural holdings: | T F |
| 9. "Agricultural holding" and "farm" are synonymous: | T F |
| 10. A small economic unit of agricultural production under single management comprising all livestock kept and land used wholly or partly for agricultural production purposes it is not an agricultural holding because of its size: | T F |

2. Please, read the following passage:

A household consists of one or more persons living together and sharing at least one daily meal. It is usually formed by a family group but it may consist of two or more families or a group of unrelated persons or a person living alone.

For each of the following statements referred to in the above passage, please circle T if it is TRUE or F if it is FALSE:

- | | |
|--|-----|
| 1. A private household is always formed by a family group | T F |
| 2. A private household may consist of only one person: | T F |
| 3. A private household is the same than an agricultural holding: | T F |
| 4. All the persons belonging to the same household must live together and share at least one daily meal: | T F |
| 5. Several families living together and sharing all the meals constitute several households: | T F |
| 6. A group of unrelated persons never constitutes a household: | T F |
| 7. A widow father living together with his small son in one house never constitutes a household: | T F |

3. According to what you have learnt in the training course, please circle T if it is TRUE or F if it is FALSE:

- | | |
|---|-----|
| 1. Every holding has a holder: | T F |
| 2. For each holding you must fill a census questionnaire: | T F |
| 3. One person can operate more than one holding: | T F |
| 4. Holdings are always operated by individuals: | T F |
| 5. If Mr. Alexandre rented out 5 acres of land <u>to</u> Mr. George and Mr. George operates this land, the holder is:
Mr. Alexandre: | T F |
| Mr. George: | T F |
| 6. A squatter of land never can be a holder: | T F |
| 7. A highway passing through a parcel divide it in two different parcels: | T F |
| 8. A farm path passing through a parcel divide it in two different parcels: | T F |

16.27 Certain reports for each census worker (enumerator and supervisor) must be completed periodically (daily or weekly) in order to measure the progress of the census operation and to tighten the inter-relations of various processes. When CAPI is used, geo-referencing and paradata (e.g. date and time of start, completion, approval, etc.) allow census supervisors to visualize and monitor the progress of the enumeration in real time. The aims of these reports are:

- ◆ To inform the census authorities of the work progress and its relation to the planned time schedule.
- ◆ To identify any deviations and problems in progress so that proper and timely action may be taken.

16.28 Enumerators and supervisors should be trained thoroughly in preparing these reports, which should be realistic and as simple as possible, with minimum data required to ensure the above aims. There should be different forms for the enumerator, the local supervisor, and the provincial coordinator.

Training of office staff

16.29 There is a need to provide long-term training in the various aspects of the agricultural census to persons who are to be entrusted with the overall responsibility of organizing and conducting the agricultural census. Countries should identify qualified persons for this training who are better placed to be in charge of the agricultural census. It is of the utmost importance that individuals who are nominated for these training courses are top officials with the requisite sense of responsibility. When countries are receiving technical assistance for the conduct of the census of agriculture, on-the-job training is usually provided by international experts to the key national census staff.

16.30 This training could be conducted at an international level. There are a few international centres offering such courses which extend from a few weeks to a year. The training should be conducted at least **three years** before the date of commencement of the census in order that a period of two years is available to make proper preparations. The training should include all financial, organizational and technical aspects of the census. The training should include in particular:

- ◆ Census methodology (census modalities and ways to conduct a census).
- ◆ Census planning design and preparation
- ◆ Census publicity campaign and communication with users
- ◆ Preparation of frames
- ◆ Sampling techniques.
- ◆ Design of questionnaire and its field testing.
- ◆ Pilot census.
- ◆ Census enumeration
- ◆ Data processing, tabulation and analysis.
- ◆ Preparation of census reports, dissemination of census results and archiving.

16.31 International training is needed for the census executives of developing countries with little experience in census operations; consequently, it is desirable to prepare the contents of such training programmes based on the experiences of past censuses conducted in other countries. International training centres, including a practical demonstration of census taking, which should be an integral part of the training and be organized in selected developing countries. The exchange of experiences in the organization of agricultural censuses between neighbouring countries and organization of study tours to similar countries are highly recommended.

16.32 A series of international courses is available on related subjects. FAO organizes a number of regional census roundtables for disseminating the latest census guidelines at the beginning of each census round. In addition, trainings on various census subjects are normally organized within countries when receiving technical assistance from FAO for the national agricultural census.

16.33 Apart from that high level long-term training it is necessary to provide specific training to programmers, editors and coders, data entry operators, cartographers. The tasks to be developed for such staff are very specific and if suitable trainers are not available in the main census office, they should be specifically contracted to perform the training activities. In general some of the groups of trainees would not be large and one or two trainers in a few venues would suffice. Anyway it depends upon the country circumstances.

Training in the use of advanced technologies

16.34 ICT has a fast development implying the need of continuous updating and specialized training. Management of new hardware and software for many of the traditional tasks in census and survey taking requires the building of new capabilities. Some of the areas where advanced technologies are substituting traditional operations are: a) use of geo-referenced information systems for mapping and measurement of areas which are very important for the definition of enumeration areas and primary sampling units; b) management of satellite images for a first identification of land use, number of buildings and other landscape features; c) use of handheld devices (such as smartphones and tablets) to collect information from respondents; d) development of internet-based capabilities to use Computer Assisted Self Interview (CASI); e) archiving and development of users-friendly online databases for data dissemination and analysis and easy and safe access to microdata.

16.35 Main census technical staff needs to be trained in such advanced technologies. Because of the specialization required both the selection of trainers and trainees should be made with special care for efficiency: trainees should be selected from the personnel with a previous qualification in the area and who will directly work on the specific technology and trainers should be specialized professionals in the respective area. International expertise may be needed for assistance in these areas.

16.36 Again, usually these training courses would be addressed to small groups and a few venues would be enough. However if the census is going to be undertaken using CAPI, a large amount of enumerators need to be trained in the use of handheld devices as noted in **paragraph xx** above and this should be added to their training programme.

Use of training aids

16.37 The quality of training can be improved considerably by making effective use of training aids. Lecturing continuously becomes dull and boring to trainees and training programmes fail if the trainees do not pay sufficient attention to what is being taught. Audio-visual aids are a great help in this respect. There is a need to ensure that every enumerator understands and applies various concepts, methods and definitions in the same way. This is particularly difficult to achieve in large countries where training has to be organized through several levels of training. Good training materials in general, and audio-visual training aids in particular, are very useful for ensuring uniformity of training throughout the country.

16.38 One of the most useful aids for trainees, to understand a subject, is a film or video. A film showing, for example, methods of interviewing holders, or agricultural and living conditions of the holders in the

country, would be found to be very effective in preparing the trainees for field work. Online films are more affordable to produce and distribute across the country (e.g. Russia, 2006).

16.39 Slides are another less-expensive audio-visual aid. Slides can be produced easily but should be prepared with a specific plan in mind. It is possible to exhibit charts, etc., on slides. Projection equipment for slides is not expensive. It is more convincing to show a slide of a map showing the boundaries of a locality and explain how these boundaries are to be used in a listing operation or a video-clip to illustrate an interview. Such examples can be multiplied. Teaching with the assistance of slides shown at specific intervals would lead to better assimilation of the subject by the trainees.

16.40 Such aids like films or slides can also be uploaded to internet in order to be downloaded and reproduced at each training venue. Charts and graphs are also very useful as training aids. The colours used in drawing a chart should generally be quite bright. The charts should be large so that they are visible from every part of the classroom. Overhead projectors and transparencies, and the blackboard, are also very effective training tools.

16.41 Generally, lectures should be interspersed with films or slide presentations. The supervisors might also need to be trained in using training aids in the classes for enumerators.

DRAFT

CHAPTER 17 ORGANIZATION OF FIELD WORK

Introduction

17.1 An agricultural census is a complex and expensive operation consisting of a series of closely related steps that must be planned carefully in advance. The first step is to make a systematic study of all activities that will be involved in an efficient census taking operation. If a census has been conducted in the past, and well-documented material relating to the census operation is available, this will help considerably in planning the present census. This is why it is important to prepare a good Technical Report at the end of every census. The experiences of personnel who worked on the previous census are also invaluable in planning the present census. Since the census is usually conducted after a long interval (5 or 10 years), many technological as well as socio-economic changes have taken place between the two censuses. Past experience alone may not be adequate for planning the current census and it is necessary to plan a programme of pre-tests and pilot censuses to study the various steps which are important in a census operation. The size of this programme may range from very small pre-test surveys intended for checking specific problems, to one or more large pilot censuses which are a final test and a rehearsal for the full census data collection. The terminology used in this section refers to all census modalities, including sample supplementary or rotating modules when the modular approach or the integrated census and survey modality with AGRIS is used.

This section discusses the main stages in the organisation of field work, the listing operation, pre-test surveys, the pilot census and the organisation of the census enumeration in central and provincial offices.

Listing operation

17.2 As discussed in Chapter 12 Mapping and Frame building, the quality of the frame for the census enumeration units (agricultural holdings) is crucial for the success of the census operation and is essential, whether it is a sample based or a complete enumeration census. The frame can be established from the list of households from the population and housing census, or area frame, or administrative records, registers or a combination of these sources.

17.3 In practically all cases, a list of the agricultural holdings will have to be prepared for each enumeration area, often using EA maps of the most recent population and housing census. The enumeration area may be a village or a segment of a compact geographical area. A clear identification of each enumeration area is essential to prepare an accurate list of agricultural holdings and to organize the field work, and usually maps or/ and photos are used. It is logical and economical to take advantage of the existing information. However, the frame needed in an agricultural census may not be readily available from information provided by other sources. In some cases, when changes in the agriculture sector are relatively rapid or the sources used for the establishment of the frame are not recently updated, it is necessary to update the frame. This update is often called "listing operation". Therefore, the objective of the listing operation is to identify the census target population.

17.4 The method of the listing operation depends on the socio-economic peculiarities of the country. Some examples of listing operations to prepare the list of agricultural holdings in the household sector are:

- ◆ Examine the lists prepared for each village, commune (or other local administrative unit) on the spot together with local leaders, important agricultural holders, members of the local

administration, etc., without visiting every household. This activity could be carried out by the regional statistical experts or experienced enumerators who will be used later as supervisors. After the update on the spot, the lists from each village (local administrative unit) are submitted to the regional offices for checking and validation, and then the listing information for the whole region is submitted to the central census office. This method is usually used in countries with compact agglomerations of houses and agricultural land surrounding the agglomeration, when preliminary lists of holdings are available. The listing is done usually several months before the start of the census data collection. It should be noted that this activity would need significant budget resources that should be planned in advance.

- ◆ Listing operation based on visits to each household in the EA. In this case, enumerators visit each household to fill-in a listing questionnaire. The listing questionnaire contains several questions allowing the enumerator to determine whether the household belongs to the census target population or not. If CAPI is used during the listing, the decision on whether the household is in the target population would be made automatically. There are different situations such as:
 - In some countries the listing phase is combined with the core module of the modular approach. These are countries where there is no possibility to establish preliminary list of holdings from other sources. In this approach all households are asked some screening questions (using listing questionnaire), allowing the enumerator to check whether the household fulfils the criteria in the operational definition for agricultural holding. For households belonging to the census target population the enumerator continues with the main interview, filling-in the census core module questionnaire. Both PAPI and CAPI data collection methods can be used. This approach is often used in countries with relatively poor road infrastructure or big distances between the households, or remote areas. The advantage of this method is that the frame for the core module is completely updated. The limitation is that this operation takes more time because all households are visited, and not only the households that fulfil the criteria in the operational definition for agricultural holding (country examples: Congo, Angola, Cote d'Ivoire, Niger, Cameroun, Burkina Faso, Togo)
 - Other countries separate the listing phase and the census data collection. During the listing phase all households are visited and the dwellings of agricultural holders that fulfil the criteria in the operational definition for agricultural holding are identified. Those dwellings could be marked with stickers or another identifier. When GPS is used, the itinerary or GPS coordinates of the holdings to be enumerated could be recorded. Several weeks or months later, the identified agricultural holdings are enumerated in the census data collection phase. One of the advantages of this approach is that the listing operation can be finalised relatively quicker in comparison with the previous case. Another advantage is that the lists obtained before the enumeration period could help to better organize the field data collection including better scope of resources e.g. the use of different skills of staff for the two phases of listing. Later, the census data collection will concentrate only on the marked dwellings. The disadvantage is that the quality of the frame depends on the time lag between the listing operation and the actual census data collection. When the latter is done not immediately after the screening, the frame would need to be updated. Depending on the nature and quality of the identifiers used, some markers can be lost (country example: Equatorial Guinea). In some cases, it is difficult to identify holdings directly; instead, land parcels is more practical to be identified. Therefore, in some countries, the first listing exercise may consist of the listing of agricultural parcels with their coordinates and information about the land operator. Afterwards in the census office, with the help of field staff the holdings are re-composed (country example: Peru, Agricultural Census 2012).

- Another possibility is to include the agricultural screening questions in the population census questionnaires (see Chapter 12 Preparation of frames for agricultural census). Depending on the time lag between the two censuses, the frame prepared with the population census might need to be updated before the start of the agricultural census (Mali, Population census 2009). In some countries the combination of different methods to prepare (or update) the list of holdings is applied (Country example: Uruguay, Agricultural Census 2011)

Pre-test surveys and pilot census

17.5 When census field work starts, all documents and procedures, such as questionnaires, instruction manuals, data checks and processing, should already have been carefully checked and tested as mistakes or problems discovered at the time of enumeration cannot easily be corrected. It is necessary to assure that such mistakes or problems are discovered and corrected at an early stage by means of pre-tests and a pilot census.

Pre-test

17.6 Before planning a pilot census, the conduct of a series of pre-test surveys is highly desirable, with the objective to test different parts of the census methodology. This includes mainly testing the formulation of concepts and definitions, census questionnaires, instruction manuals, duration of interviews, etc., and the evaluation of alternative methodologies and data collection methods. Pre-test surveys differ from the pilot census in that they are usually relatively small-scale exercises, aiming to test part of the census instruments and not the entire organisation, and the selection of respondents is often not on a random basis. However, in large countries and where methodological considerations need to be fully evaluated, a pre-test survey may need to be conducted on a fairly wide-scale and rigorous basis.

17.7 The pre-test survey is particularly important for the formulation and wording of the questionnaires. Many countries concentrate their testing on new topics or questions, but it is also important to test the impact that these new questions may have on other questions on the questionnaire. A series of pre-tests should be organized after the draft questionnaire is ready. The main purposes of questionnaire testing are to make sure that the questionnaire is:

- ◆ **Functional:** All aspects of the questionnaire (including the question texts, response options, missing values, branching, routing instructions, error messages, data transfer, etc.) work as specified under all possible situations.
- ◆ **Usable:** The enumerators can effectively and efficiently make use of the questionnaire to collect necessary data.
- ◆ **Accurate:** The questions are able to elicit accurate data.
- ◆ Length of the questionnaire and duration of interview

17.8 The objectives of the questionnaire's pre-test are to determine whether the enumerators use the concepts and definitions in a uniform manner, whether respondents understand the questions, whether the order of the questions is acceptable, and how long it takes to obtain the information. Questionnaire designers can also act as interviewers or can observe the interviews conducted by the staff dealing with data collection. The presence of an observer may influence the behaviour of both the holder and the

enumerator, possibly distorting the results of the interview; however, this influence may be preferable to not having any observers as enumerators concentrating on recording data may miss some details. It is very important that specialized staff have an opportunity to observe how respondents react to the inquiry and how they and the enumerators are able to understand the various terms and concepts used in the census. As a result of this test the concepts and definitions and the way they are translated into questions should be finalized, together with the arrangement and sequence of the questions, the appropriateness of the language, format of the questionnaire, spacing between two questions, adequacy of space for writing answers (the latter - in case of PAPI), etc. It should be possible to finalize the various aspects of the questionnaire by interviewing a relatively small number of holders.

17.9 Pre-tests should also examine how to control the respondent's bias (see paragraph 18.12). Through pre-test surveys such biases should be carefully studied and appropriate solutions obtained.

17.10 Further tests may be carried out in different agricultural zones of the country. Staff who are likely to be employed as enumerators or supervisors should be used as interviewers and the technical staff act as observers. Enumerators and observers should be asked, on the basis of their interviews, to give their opinion on the questionnaire. The opinions of the interviewers and observers should be jointly discussed to finalize their comments on the questionnaire. Sometimes, instead of testing only one questionnaire, two or three alternative questionnaires which have different formats or which include different items or which formulate the questions in a different way are tested. On the basis of the results of the test it would be expected to find the most practical questionnaire or format. Different methods of enumeration, such as PAPI or CAPI, could also be tested at this stage, in order to identify the most appropriate method.

17.11 The task of questionnaire pre-tests is often entrusted to a group of agricultural census and survey experts. This group should be made responsible for testing the suitability of questionnaires in actual field conditions. There can be situations specific to certain countries where telephone pre-testing with industry experts would help clarifying questions prior to testing with respondents. Obviously, such tests should be conducted under varying socio-agro-economic conditions and the results and analysis of the tests should be submitted to the national agricultural census committee. The report should give concrete and constructive suggestions on the revision of questionnaires, it should, in particular, emphasize the alternatives of the questionnaires which either need to be abandoned or revised. It should critically examine every question included in the questionnaire from the point of view of (i) the reaction of the respondents and quality of information furnished in the answers (ii) the reaction of the interviewer and difficulties they faced in extracting the information and (iii) usefulness of every question from the point of view of data obtained and tabulation planned.

17.12 An agricultural census operation involves the collection of data on a relatively large number of items. Most of the characteristics on which data are needed are of a quantitative nature. In many developing countries holders do not keep records of their holding. Collecting data through an interview could have many limitations such as: the holders have no quantitative concepts, or they fail to recall accurate information and consequently errors are introduced into the census data. There may be items on which accurate information can only be obtained by using objective methods of measurement (see Chapter 18 Census data collection methods). Therefore, different measurement methodologies will need to be pre-tested in the surveys to find appropriate measurement techniques for different specific items.

17.13 The pre-test stage is necessary for all modalities of census taking. When modular approach is used, the results and analysis of the pre-test would help when deciding on the distribution of items between the core module and the supplementary modules questionnaires. In the case of use of administrative data the evaluation of the quality and relevance of the administrative sources and registers is part of the pre-test.

17.14 The pre-test is highly recommended also when decision is to be made on the method of data collection to be used for the census, especially when a new method is envisaged such as CAPI, CATI, mail-out/mail-back, drop-off/mail-back (or pick-up) or CASI. These pre-tests should be made well in advance and in addition to the above mentioned objectives, should cover the data capture software and application, data transmission protocol (for CAPI, CATI and CASI), the non-response rates, plausibility of responses, check and controls, and the integration of the data in the census database.

The pilot census

17.15 The pilot census is the final test, a 'dry run' for the main census but on a limited scale. All aspects of enumeration, processing and dissemination systems, and the interface between them are tested to resolve any outstanding problems. The results should be used when drawing up the final plans for the census and to provide a basis for the final calculations of resource requirements for the census. The questionnaire design should be almost final at the time of the pilot census and should not undergo substantial changes after the pilot.

17.16 It is recommended that the pilot census takes place well in advance of the actual census enumeration to have sufficient time to analyze the results of the pilot census and resolve any problems identified. Pilot censuses should be taken under realistic circumstances. In other words, all the possible conditions which are likely to be faced in the main census should be reflected in the pilot census. It must cover the divergent situations existing in the country. A well-organized pilot census will help to improve the efficiency of the main census. A certain portion of the total census budget should be earmarked for pilot studies. The pilot census should be large enough to provide adequate information for determining the resource requirements (budget, personnel, transport, average time for an interview, etc.), method(s) of data collection, data checks and monitoring of the field work, data transfer, mode of tabulation, timetable, various types of biases and errors likely to occur in field data, etc.

17.17 A well-conducted pilot census must provide adequate technical inputs for improved planning of the main census. The effort put into conducting a pilot census is wasted if the results are not made available in time for the efficient planning of the main census. A critical report on the pilot census mentioning the main objectives, the sample design, and the various stages of planning and implementation and lessons learnt from the pilot census, must be available well in advance of the start of the main census data collection. Even though the results of the pilot census may not be statistically representative, tabulations and derived tables should be produced to test the process through the final stage. Suggestions for changes in the material prepared for the pilot census and in procedures and methods followed should form part of the report. The suggestions given in the report will form the basis of the census operation for the country. They should, therefore, be examined and evaluated by all authorities concerned with conducting the census. The national agricultural census committee should take all these suggestions into account before finalizing the operation of the main census.

Table 14.1 Census testing

Questionnaire Testing (pre-tests)	Pilot Census
<ul style="list-style-type: none"> • Small scale • Test the suitability of <ul style="list-style-type: none"> ○ the intended census questions, including their formulation and the instructions provided ○ questionnaire design • Test in general public and special population groups • Estimate time requirements in enumeration • Several rounds may be done • Test the data collection methods (e.g. paper, tablets) 	<ul style="list-style-type: none"> • Larger scale • Test the entire census infrastructure • Cover one or more sizeable administrative divisions • Test all stages of a census: preparatory, enumeration, processing and dissemination • Best if conditions in the pilot census are close to the conditions present during the actual enumeration • Ideally conducted exactly one year before the planned census, if not at least 6 months before • Pilot census data do not produce usable substantive data. But analysis of errors from the data may be informative for identifying problems

Source: Adapted from the Handbook on the management of PHC rev 2 (UN)

17.18 One of the main purposes of pilot censuses is to provide elements required for revision of the cost estimates and work-plan. A fairly clear idea of what is needed should exist at a very early stage. As enumerators constitute the major component of the census labour force, the pilot census should provide data for analyzing the time required for filling the various questionnaires by enumerators. The enumerators are usually asked to record time taken to complete each field operation, such as contacting the holder, extracting the relevant information from the holder, etc. A critical analysis of time records will help census management staff to better estimate the duration of the data collection, number of enumerators needed and to distribute the workload among field enumerators. It will also help in assessing the requirements of enumerators and supervisors for the main census and thereby an estimate of the cost of the enumeration phase of the census. Information on the cost of training enumerators for the pilot census will also be useful for budget planning.

17.19 Similarly, field equipment requirements and logistics (transport equipment, equipment for objective measurements and cartography if applied, distances and quantity of fuel needed, etc.) can be assessed in a pilot census. Testing data entry and data processing procedures with raw data will help assess the computer equipment and data entry requirements. In case of use of CAPI, CATI and CASI the pilot census provides also useful information on possible problems during the data collection, transfer, data linkage and problems with the devices and batteries (more details for using CAPI see Chapter 18 Census data collection methods).

17.20 Pilot censuses are an excellent opportunity to provide on-the-job training to all supervisory staff. The supervisors are entrusted with the supervision of the field work of a large number of enumerators with different backgrounds, thus their training must be very intensive and thorough. The supervisors must be trained to become good enumerators. They must attain a thorough knowledge of agricultural census operations so that they are in a position to remove the doubts and difficulties of the enumerator. After the pilot census it can be determined if the supervisors' training was effective and what changes have to be made before training enumerators.

17.21 During collection of census data, both enumerators and holders contribute to errors. It is necessary to know, through pilot studies, the types of errors that these two groups of individuals make. Once the weaknesses of the enumerators are identified, it should be possible to remedy them through careful preparation and efficiently structuring the questionnaires and instruction manuals, by training enumerators, providing adequate facilities and incentives for their work, and by exercising close supervision.

17.22 Census data are summarized in the form of tables which provide a descriptive picture of agriculture. The pilot census data should also help in determining whether necessary tabulations can be produced easily. The tabulation plan of the pilot census data should be a miniature of the main census. A careful tabulation of the pilot census data would also point out the deficiency of the questionnaire with respect to coverage of items needed.

17.23 Some preliminary tabulation of individual segments or at village-level can be done by field enumerators and supervisors. The pilot census can determine what kinds of tabulations can be entrusted to field enumerators and supervisors. Often, with proper training, the work of evaluating, minor editing and coding of data may be decentralized and entrusted to field supervisors. The use of CAPI for field data collection could significantly facilitate this process

17.24 If the census is based on a sample, a proper estimation procedure will have to be adopted. There are several improved estimation procedures which can be used to derive the estimates of total population for each variable. Estimation procedures, such as a ratio method and/or regression method, depend on supplementary data. At the pilot stage it should be possible to examine the kind of supplementary information needed to improve the method of estimation, and once the appropriate supplementary variable has been determined, information on it can be collected as an integral part of the main census operation.

17.25 Processing pilot census data provides an opportunity to test the ICT infrastructure and to make some necessary adaptations before launching the census data collection. Various procedures for checking data, data entry, manual and computerised data corrections, etc., must be checked with raw data. Time is a factor which should be examined while tabulating the pilot census data. If the census results are to be useful, these must be made available to the users in a timely manner. To achieve this objective, a timetable of various phases of processing census data can be formulated with the help of the pilot census. It should be noticed that the computer assisted data collection methods (CAPI, CATI and CAWI) can considerably facilitate data processing process and thus, reduce the time lag between the data collection and dissemination. A rational decision about the mode of tabulation and the requirements of manpower and equipment can be taken on the basis of tabulation of pilot census data. At the pilot census stage, it is important to consider alternative processing methods and all their implications, including speed, efficiency and cost, by preparing all tables by different methods. When CAPI, CATI, CAWI or combined data collection is used, all methods have to be tested in the pilot census, together with the procedures for transferring, merging and processing data coming from different collection methods.

Organization of census enumeration

17.26 This part refers to all census modalities where the information is collected through face-to-face interview from the respondents by PAPI or CAPI data collection method.

Census office

17.27 As discussed in Section 3.2 “Institutional framework”, the primary and chief responsibility for implementing the census rests with a single government department, i.e. the census office.

Provincial offices

17.28 In order to provide immediate supervision in each area, field offices at various levels, such as at the provincial and district levels, are often established for the census preparatory work, including field organisation, staff recruitment and training, as well as for the field data collection.

17.29 The provincial and district offices coordinate the activities of the field and supervisory staff in the province or district. These offices can also assess day-to-day transport requirements and pool transport facilities for census operations in the province or district.

17.30 The provincial offices can organize intensive training courses of small groups of enumerators and their supervisors in the province with reference to specific local conditions and problems. The enumerators and supervisors in a province can be gathered together more conveniently at a provincial office to discuss problems that might appear common to these staff. Some trained enumerators can be kept in reserve at provincial level to fill vacancies arising from resignations, sickness, etc.

17.31 The supervision of field work, the prompt resolution of mistakes, the ability to resolve problems and to motivate enumerators in problematic situations (difficulties related to access in remote areas, behaviour of agricultural producers, complex relationships between household and holding, etc.), to gather completed questionnaires from the enumerators and to complete review of questionnaires and their evaluation in consultation with enumerators can best be organized from a provincial office. Transfer of enumerators from areas where work has been completed to other areas where the work is lagging behind or is not satisfactory can be assessed and resolved promptly from a provincial office.

Monitoring and control of questionnaires' flow

17.32 The agricultural census is a large operation usually involving hundreds of thousands of questionnaires. In the case of complete enumeration in larger countries there may be millions of questionnaires. A rigorous procedure for registration of completed questionnaires should be established in provincial and central offices to ensure that all enumeration areas in the country and all agricultural holdings within each enumeration area are accounted for.

17.33 In PAPI data collection special control measures are required to ensure that all questionnaires are received. Adequate physical storage space should be made available in time to avoid damage or misplacement of questionnaires. When the completed questionnaires are returned by the enumerators, they should be transferred through supervisors at different administrative levels to the designated

processing centre (central or provincial offices). To simplify control measures, questionnaires should be grouped by geographical areas and identified by appropriate forms relevant to the filing system adopted.

17.34 During the processing, questionnaires are removed from storage many times for manual editing, data entry and verification, checking of figures when computer editing detects potential errors, etc. Strict control during this phase is essential but difficult. It is important, therefore, to establish very rigid control over the flow of questionnaires and to make periodic reviews in order to detect misplaced questionnaires. Good organization in filing the questionnaires will greatly facilitate control.

17.35 Central and provincial offices have similar responsibilities also when mobile data collection methods are used (see Chapter 18 Census data collection methods) with the exception of training and transport plans for the enumerators. However, for these data collection methods more rigorous organisation of supervision and management of the lists for returned questionnaires, refusals and reminders is needed.

Census field staff

17.36 As discussed in section Chapter 15 - Staffing, the census field staff, supervisors and enumerators, play a critical role in the conduction of agricultural census and their duties should be strictly defined.

17.37 Enumerators are responsible for accurately recording all required information on the agricultural holdings in an assigned area and reporting the progress to their supervisors. Since an agricultural census is taken at periodic intervals it can be conducted either entirely with the help of new part-time or temporary enumerators or by supplementing the field staff already employed for annual surveys with new temporary enumerators. These temporary enumerators may have little background or knowledge of agriculture, the agricultural census and local conditions. They will require intensive training, supplemented with considerable practical work, field demonstrations, tests and exercises. It should be noted that replacements may need to be found for temporary enumerators quitting in the middle of the census operations.

17.38 Extension assistants or field officers of the Ministry of Agriculture are a good source for enumerators or supervisors. They have the advantage of being familiar not only with the boundaries of the enumeration areas within their jurisdiction, the terrain, and land use and crop cultivation practices, but also with people whose cooperation they can easily obtain. In practice, only part of the extension agents can be made available to assist in the census work due to other activities they have during the same period. The advantages and disadvantages of the use of extension assistants should be carefully studied before taking the decision.

17.39 It is advisable that the field staff, particularly the supervisors and enumerators, live in the places where they are working. Staff who are unfamiliar with local conditions have many disadvantages: they cannot move around easily, they may not be trusted by holders, they may not be able to communicate easily with holders since they may not know the local dialect and may not be familiar with local units of weights and measures.

17.40 Considering the extent and nature of the responsibilities of supervisors (Chapter 15), a supervisor can effectively supervise five to ten enumerators. In difficult areas with poor transport facilities and with remote and suspected non-cooperative farming communities, a supervisor should not be responsible for more than five enumerators. In areas with good transport and communication facilities and where holders and enumerators are familiar with censuses and surveys this number may go up to ten.

17.41 The field work can be organised in different ways. In some cases the supervisor gives certain number of EAs to each enumerator. This is practiced mainly in cases when enumerators with local knowledge are recruited. They can work alone in their jurisdiction as they will usually get cooperation from holders.

17.42 In other cases it maybe decided that a small team of supervisor and enumerators is established and they work together on all EAs assigned to the supervisors. This may be desirable in difficult areas with poor transport and communication facilities. Sometimes, for safety reasons it is better to work in teams. (country example; Cote d'Ivoire)

17.43 The advantage of this organisation is that enumerators in a team can discuss their problems, difficulties and experiences to mutual advantage. Organization of enumerators in teams can be especially advantageous if there are a number of new and inexperienced enumerators. The team serves as in-service training until the new enumerators are ready to work independently.

17.44 However, in a team, enumerators are likely to duplicate or omit a certain amount of work or waste time if there is no proper organization and distribution of work among the team members and adequate supervision of their work. With the use of an advance technology (GPS - built-in or a separate device) the distribution of work within the EA and the monitoring are much easier and more efficient.

17.45 The decision as to whether enumerators should be organized in teams or work individually in separate allotted areas will depend on the conditions and type of census organization in a country. Even if enumerators work independently in separate areas, they can be treated as members of a team in a supervisor's zone or in a district to ensure balanced progress of field work over all the zone or district. The workload in some enumeration areas of a supervisor's zone may be heavier than in others. The supervisor should be able to transfer enumerators from areas where work has been completed to areas where an increased number of enumerators are needed.

Supervisory work

17.46 Supervisors are responsible for performing quality checks according to the quality assurance plan for the census on the work of enumerators (see Chapter 7 Quality assurance framework). This includes the following:

- ◆ Observing interviews during enumeration: For supervision to be effective and useful during the initial period of an enumerator's work, including identification of enumeration areas with the help of maps and boundary descriptions and listing of households, it should be done while the enumerator is on the job. The supervisor should accompany the enumerators to several initial

interviews and objective measurements, observe their work closely and take immediate measures to correct any noticeable shortcomings.

- ◆ Checking holdings already enumerated: Supervision can be efficient and objective by checking a random sub-sample of enumeration areas and holdings, involving an element of surprise. The supervisor's observations, along with the data entered by the enumerators, can be recorded on a special supervision form (if PAPI is used) or directly on the mobile device or PC (if CAPI or CATI is used). This will provide an assessment of the nature and extent of errors committed by enumerators and what corrections are necessary. Such a programme of supervision will take considerable time in face-to-face interview. In some countries this supervision is done by telephone but this depends on the countries' peculiarities.
- ◆ Checking coverage of the EA: this can be done by reconciling the forms in the enumeration record with the maps. When using CAPI, usually the software provides information on the coverage in the reporting menu.
- ◆ Reviewing completed census forms: Supervisors should check a sufficient sample of questionnaires to ensure their completeness, accuracy and consistency.
- ◆ Reviewing monitoring and evaluation data for the area under supervision: Supervisors are also responsible for monitoring the progress of enumeration for the area under their supervision. In a PAPI data collection method, many of measurements generated during enumeration are intended for analysis later. When CAPI is used this information can be used to provide real-time quality assurance. These measurements may include:
 - Percent of agricultural holdings visited in an enumeration area
 - Time taken to complete each question/questionnaire
 - Number of questionnaires completed per day
 - Percent of units not interviewed (refusals, non-contact, etc.)

Source : SDS6 and Handbook on the management of PHC rev 2 (UN)

17.47 Supervisors may be responsible for monitoring these measurements and reporting abnormalities to the census office or taking predefined actions to remedy the situation. Exact procedures should be determined during the planning phase of the census to reduce as much as possible situations in which supervisors must make ad hoc decisions to respond to enumeration abnormalities.

17.48 The supervisors should be directly involved in collecting the questionnaires from the enumerators and forwarding them to the census headquarters. When CAPI is used the data transmission of the questionnaires can be organised even on a daily basis depending on the internet coverage of the area. The supervisors can refer back to the enumerators all incomplete and incorrect work while in the enumeration area in order to rectify mistakes. The supervisors should be provided with guidelines not only for supervising the field work but also for scrutinizing completed questionnaires. Editing work at headquarters can be facilitated considerably if the supervisors are required to check the completed questionnaires for accuracy and consistency before forwarding them to headquarters.

Box 17.1 Use of CAPI for management of the data collection (with Survey Solutions software)

As already described in text box 18.3, the Survey Solutions (SuSo) is a CAPI product developed by the World Bank with support from the FAO Global Strategy to improve agriculture and rural statistics, consisting of several tools.

The SuSO **survey management tools** are built into a web interface connected to centralized server which stores the data and keep track of the questionnaires. As interviews are conducted on tablets, the enumerators can transmit completed questions to the server, and survey management and reporting features make it easy to monitor ongoing surveys. The below photos demonstrate two of the reporting features. The first shows the number of interviews at each stages (i.e created, completed, approved, etc.), and the second is a map report which can be used for questions capturing geo-references.

The screenshot displays the Survey Solutions web interface. The top navigation bar includes 'Headquarters', 'Reports', 'Interviews', 'Supervisors', 'Questionnaires', and 'Administration'. The main content area is titled 'Surveys and Statuses' and features a table with the following data:

Survey Name	Created	Supervisor assigned	Interviewer assigned	Completed	Rejected by supervisor	Approved by supervisor	Rejected by HQ	Approved by HQ	Total
Household Survey 2016	0	1	0	0	0	0	0	0	1
Household Survey 2014 / 2015	0	1	0	0	0	0	0	0	1
Household Survey 2014	0	1	0	0	0	0	0	0	1

Below the table is a map view showing a geographical area with a red pin indicating a specific location. The map includes a sidebar with 'Current location on map' and 'Add markers on map' options.

Enumeration work

17.49 The number of enumerators needed for the census operation in a country will depend not only on the volume of work and the length of the survey period, but also on the intensity of agriculture, the number of crop seasons over the year and the terrain to be covered. In many developing countries which have one to two crop seasons, the terrain may be difficult, transport and communication limited and movement from one enumeration area to another time consuming. The holdings in an enumeration area may also be far apart. It is difficult to recommend a general workload to be assigned to an enumerator. This workload will depend on the content of the questionnaire, whether the enumeration area is compact or widely spread and transport and communication arrangements. Time elements required when planning these activities can best be obtained from pilot censuses. Perhaps the most important time factor is whether plans for objective measurements for areas are included as this operation is very time consuming. While enumerators may be able to interview five or more agricultural holders a day, they may need a whole day to measure the area of all parcels of one holding. Experience shows that at total for the census not more than 100 to 200 holdings should be assigned to an enumerator if no objective measurement is done, and only 20 to 50 if objective measurements are to be included.

17.50 If the enumerators are natives of or reside in the area where they are assigned, they will be known by the people and can usually get maximum cooperation, and when they need assistance for some operations they may be allowed to choose a helper. However, if they are new to the area, they have to be introduced to village leaders and people by their supervisor or senior local administration or extension agents. In some countries, the chief or the village leader has to arrange for their accommodation and, if necessary, a meeting with the people at which the enumerator can explain the objective, need and importance of the operation, and request their cooperation. The chief or the village leader may have to assign to the enumerator a helper who is familiar with the people and is well informed about agricultural practices in the area. This helper may be selected from those who usually work, or have worked, on similar missions in the past.

17.51 These helpers can guide the enumerators around the area, take them from one household to another and to different fields and cattle-sheds if required. If needed, they can also assist enumerators to harvest crop-cutting plots and in drying and threshing the harvested produce. They can help to make appointments with holders in advance and carry messages.

General suggestions for preparing the face-to-face interview

17.52 The enumerators should plan their daily routine for interviewing. It is important that the enumerators plan clearly what they want and hope to accomplish in a stated time frame. It may be desirable, especially for beginners, to write down these objectives, and spell out possible problems and possible solutions. In other words, they should plan and decide what is to be accomplished and when they will do it.

17.53 It is desirable to have advance information about the area of enumeration and the people to be interviewed. The enumerators should learn as much as possible about the place where the interview will be conducted and the persons to be interviewed. What needs to be known will vary with the situation, but the general principle is knowing the respondents. This is the advantage of a local enumerator. If the area involved is of one cultural group, it is often wise to interview the leaders first to enlist their cooperation and to have them recommend and introduce the enumerator to others in the group. The principle of interviewing the leaders first not only applies to cultural groups, but is also applicable to

organizations or institutions. The persons in charge should be approached first and their cooperation secured before interviewing others in the organization or institution. For example, when a large cooperative farm is to be interviewed, the president is first contacted with the aim of explaining him/her the objectives of the census, and then the interviewer should ask for appointment for interview and eventually for the name and the position of the respondent, if the president is not available.

17.54 If possible, appointments should be made in advance. The date the census will begin is often announced through publicity and news in media. In some countries, every household is requested to have somebody present in the house during the time the interviewer is expected to be in their vicinity. The enumerators can of course make their own appointments, and in this case should have some knowledge of the respondents' daily routine to ensure appropriate times and places are selected for the interviews.

This general suggestions are also valid for the telephone interview (CATI).

Field enumeration kit and tools for face-to-face data collection

17.55 The kit and tools needed for field data collection vary depending on the method of data collection, content of the questionnaire, countries' conditions. In this regards the list of items below is indicative.

17.56 Kit for data collection:

- ◆ For CAPI method:
 - CAPI device (Tablets, PDA, smartphone)
 - several paper copies of the questionnaire, in cases when there is a problem using the device
 - Spare battery (could be solar battery)
 - USB memory stick
 - Spare SIM card from different provider (optional)
 - Instruction manual in hard copy
- ◆ For PAPI method:
 - Paper questionnaires
 - Instructions manual
 - Calculator
 - Pencils
 - Eraser
- ◆ In addition, for both methods:
 - GPS device (if not incorporated into the CAPI device)
 - Waterproof bag
 - Maps of the area assigned (if not incorporated into the device)
 - Badge for identification
 - Clip-pad
 - Torch
 - First aid kit
 - Water kit
 - cell phone or list of emergency numbers/names in case there is an emergency

If physical measurements is to be performed (mainly in the supplementary modules in the modular approach):

- ◆ Animal counter
- ◆ Crop-cutting tools
- ◆ Scale, etc.

17.57 During the data collection enumerators travel from one place to another, often facing with unfavourable weather conditions or other obstacles (snakes, spiders, mosquitoes, etc). In addition to the kit needed for the collection of data, the following equipment for the enumerators might be useful:

- ◆ Raincoat
- ◆ Rubber boots
- ◆ Mosquito /snake/spider protection kit

DRAFT

CHAPTER 18 CENSUS DATA COLLECTION

Census data collection is a key census phase and the success of the census depends on it being done quickly, efficiently and with proven methods. This chapter describes different methods which can be applied in agricultural censuses, such as face to face or remote data collection, interviewing, or objective measurement etc. The use of new technology and tools is also discussed as they are playing a growing role for census data collection, (remote sensing, GPS and mobile devices). There are also references to specific problems, such as mixed cropping, continuous harvesting, shifting cultivation and nomadic livestock etc. Detailed instructions are given on how to approach holders in order to gain their confidence, collaboration and cooperation.

Particularly relevant are the following related topics: Instruction Manuals (Chapter 14), Training Programme (Chapter 16) and Organization of the Field Work (Chapter 17).

Introduction

18.1 An agricultural census operation involves the collection of data on a large number of items. Most of the characteristics on which data are needed are of a quantitative nature. There are several ways of collecting data during a census and the choice between data collection methods is influenced by several factors, including⁸²:

- ◆ costs,
- ◆ coverage of the target population,
- ◆ literacy and education of respondents
- ◆ flexibility of asking questions,
- ◆ respondents' willingness to participate and
- ◆ response accuracy.
- ◆ Availability of holding level accounting or book keeping

18.2 Two broad categories of data collection methods are commonly used (i) face-to-face data collection or (ii) remote or self-enumeration data collection. A combination of the two methods can also be used in one census. The decision regarding the method of enumeration should be taken in the early stages of census planning.

18.3 In addition to the methods used, new technology and tools play an increasing role in census data collection. The practical application of each method in the field vary from one country to another and with the use of a new technology, there would be many variations of application of the method. Whatever the method used, there are also special issues that should be addressed when collecting census data. This includes such as mixed cropping, continuous harvesting, shifting cultivation and nomadic livestock etc.

Box 18.1 Strategy for data collection: Iceland, Census of Agriculture 2010

Data were collected using a mixed mode strategy, starting with the most inexpensive mode first and ending with the most expensive. First a pre-notification letter was sent to all individuals with an agricultural unit informing them that an invitation to a web survey would be sent in a few days. In the invitation letter respondents were provided with a web address for the web questionnaire as well as login name and a password.

For sample units that did not respond through the web, a paper questionnaire was sent, along with a pre-paid return envelope. This was done approximately two weeks after the original invitation to the web questionnaire. Three employees of Statistics Iceland entered in answers from the paper questionnaire to a database. Finally, for those who neither answered the paper questionnaire nor the web questionnaire, a computer assisted telephone interview (CATI) was attempted.

Source:

DATA COLLECTION METHODS

⁸² See https://en.wikipedia.org/wiki/Survey_methodology#Modes_of_data_collection

18.4 This Chapter presents general information about application procedures of each type of method of enumeration and the potential benefits and limitations of each method.

Face-to-face data collection

18.5 In the face-to-face method, the questionnaires, whether on paper or electronic, are completed by an enumerator who conducts necessary field inquiries and records the information on the census questionnaire. Face-to-face data collection method is by far the most widely used for agricultural censuses, particularly in developing countries.

18.6 The Face-to-Face method has the following advantages [UN Census management 2015]:

- ◆ Enumerators can be well trained in the concepts, instructions and procedures;
- ◆ In areas of relatively low literacy, the meaning and purpose of the census questions can be better conveyed to the people by oral communication rather than through printed or electronic material. Such direct interviews by the enumerators elicit prompt replies, and cases of reluctance to cooperate can generally be settled during the course of the enumeration itself;
- ◆ Within an enumeration area, the information is likely to have fairly uniform quality and consistency;
- ◆ More complex questions can be included in the census than would otherwise be possible.

18.7 The method involves the travel of the enumerator to the holder's home or lands to record the data using paper-based questionnaires or electronic questionnaires using portable devices such as laptops, mobile devices, etc (see section... on questionnaires). Data can be obtained through *interview* with the respondent or *objective measurement* or both.

Interview

18.8 In the interview mode, the enumerator asks a series of questions to the holder and records the responses in the questionnaire.

18.9 Collecting data through an interview will face many challenges in developing countries. Often, the respondents have no quantitative concepts, and even if they do, many of the agricultural operations are such that the respondents fail to recall accurate information and consequently errors are introduced into the census data. Respondents may not even know in definable units of measure the amount of land they operate, particularly in areas where cadastral records do not exist. Another example of difficult items are those related to the agricultural labour on which reliable information usually cannot be obtained with a single interview. Similarly, data on production of agricultural commodities may not be readily obtained in one visit, particularly if the holder cultivates several crops spread over the entire production year. It is not easy to obtain data on the number of trees, or on age and species of livestock numbers, etc., through simple oral inquiries. In fact, different methodologies of procuring the data from respondents will have to be developed and this will depend on understanding his (her) socio-economic status (local customs may influence the respondent's willingness to provide data such as livestock numbers for some herders in Africa) . Pre-tests surveys should provide guidelines on the methodology to be adopted to collect data on different specific items.

18.10 Pre-tests should provide the information necessary to identify those items in the agricultural census for which data can be obtained through interview with specific reference dates. There may be some items for which there cannot be a reference date but only a reference year. There may also be items on which accurate information can only be obtained by using objective methods of measurement. Some data items, such as crop areas, are difficult to collect on a complete enumeration basis in some countries when physical measurement is needed and cost considerations may not favour such an approach. In these situations it will be necessary to conduct sample surveys. One of the main objectives of pre-test surveys should therefore be to find appropriate measurement techniques and define the types of enquiries that can be used in the main census.

18.11 During collection of census data, both enumerators and holders contribute to errors. It is necessary to know, through pilot studies, the types of errors that these two groups of individuals make. Once the weaknesses of the enumerators are identified, it should be possible to remedy them through careful preparation and efficiently structuring the questionnaire and instruction manuals, by training enumerators, providing adequate facilities and incentives for their work, and by exercising close supervision

18.12 It is more difficult to control the respondent's bias. In many developing countries holders are frequently illiterate, often lack a quantitative understanding of their agricultural operations and cannot interpret the questions correctly. In the absence of any record-keeping, they are not able to give reliable information for operations spread over the whole year from memory only. There may be other serious reasons why holders are unwilling to report correct information. They may show apparent cooperation with the census enumerator but have an ingrained suspicion and fear about the inquiry and the use to be made of the information given. In countries engaged in land reform programmes, fear in the minds of the holders is more intense. They may also be superstitious and fear that disclosure of precise information about their assets may bring bad luck. Through pre-test surveys such biases should be carefully studied and appropriate solutions obtained

18.13 While actual measurements are desired and possible in respect of items such as land use, and crop areas, information on items such as livestock numbers, machinery and equipment, holding population and employment, etc., will have to be collected by interviewing the holders despite the challenges mentioned above. It is useful (if possible) to make provision for physical verification of part of the information obtained by interview. This can be done at all three stages, namely by the enumerators themselves in the process of enumeration, by supervisors and in a programme of post-enumeration evaluation. Systems of adequate cross-checks of information on related items at the inquiry stage can be developed. This will not only improve the quality of the data, but will also give the enumerators an insight into the types of mistakes respondents are likely to make and the precautions to be taken to avoid them. These cross checks are considerably facilitated with the growing use of electronic questionnaires and portable devices such as CAPI systems, which include skip patterns and validation conditions at data collection level (see paras... for more details)

18.14 In the interview method there are various techniques used to obtain reliable data. To get the right answer to a question often a number of indirect questions will have to be used by the interviewers. They may also have to give background explanations in the dialect in which they are interviewing the respondent in order to communicate the proper meaning of the original questions. Enumerators should be encouraged to note the data and other information that they secure through conversation with the

respondent so that they can summarize this material in the form of explicit answers on the main questionnaire. Instead of a separate notebook, space may be provided on the questionnaire itself, in a dedicated space such as the back of the sheets, to record the data from which the final answer to each specified question in the questionnaire is to be built. Provision should be made also in electronic questionnaires for recording such information.

18.15 Ascertaining the area of an agricultural holding will illustrate this point. The respondent is hardly expected to understand the definition of a holding. The enumerators can obtain from the respondents all land which is connected in one capacity or another, irrespective of its location in the village or locality in which they reside, or in any other area and then adjust all land which they may own but do not use themselves, as rented to someone else, including land which they may have rented from someone and again sub-let out to someone. The enumerators may have to interpose a suitable statement reassuring the respondent of the confidential nature of the information they have reported and that it is intended to provide correct data on land use, cropping patterns, tenancy systems, etc. The use of electronic questionnaires with appropriate software packages will facilitate this process. Obviously, in the interview, the responsibility of obtaining accurate information lies with the enumerators. For this reason enumerators have to be thoroughly trained on concepts. They are also given tips to use in the interview methodology. In addition, a detailed instruction manual is supplied to each enumerator to be consulted when needed. The content of the instruction manual was described in Chapter 14.

18.16 Enumerators are normally expected to enter "zero" answers in the questionnaire. This is very important in order to make sure that they did not forget to ask a question. In "Introductory questions" such as "Any livestock?" (see Chapter 14), interviewers would skip all detailed questions for holdings with no livestock. Again, this process is considerably facilitated when CAPI is being used with the skip patterns.

Some tips on interviewing

18.17 The interview method of data collection is normally the main method used by census enumerators. In addition to the details above, much has already been said in Chapter 14 Instruction manuals and Chapter 16 Training programme about this method. Some organizational aspects will be described in Chapter 17 Organization of field work. This Section includes practical advice on interviewing respondents.

18.18 The enumerator should establish a relationship of confidence. The first step is often the most difficult for the enumerator because during the initial contact the respondent needs to be motivated to permit the interview. The ideal atmosphere for such motivation is one of mutual confidence. It must also be based on a genuine and deeply-felt respect on the part of each participant for the other person. It is the enumerator's responsibility to take the lead in establishing a relationship of mutual confidence.

18.19 Ordinarily the enumerator would proceed as follows:

- ◆ Identify and introduce her/ himself by showing an official identification card⁸³.

⁸³ In many countries, census field personnel wear dedicated T-shirts and caps with highly visible census logo to facilitate their recognition as census agents.

- ◆ Explain the purpose and objectives of the census.
- ◆ Describe the method by which the respondent was selected, if sampling is used.
- ◆ State the confidential nature of the interview as provided by the census law.

18.20 In many cases this will secure cooperation and confidence. Most people are anxious to talk about themselves and to give their views. Common politeness, mixed with curiosity, does the rest. Rural populations are usually simple and known for their hospitality.

18.21 The enumerator should help the respondents feel at ease and ready to talk. To achieve this, the enumerators should also be at ease. They can demonstrate to the respondents their confidence by using an informal and natural (conversational) manner of speaking. They should begin with a conversation on items of mutual interest, such as the ball game or the weather. They should carry on such a conversation to allow the respondents a little time to get accustomed to the situation. However, this conversation should not be prolonged as it may suggest to the respondents that the interviewers are reluctant to deal with the real purpose of the interview, and the respondents' time is valuable.

18.22 Good interviewing means asking the questions properly and recording the answers accurately. The enumerators are expected to ask all applicable questions, to ask them in the order presented and to make no unauthorized variations in the wording. The asking of questions in different ways will affect the way they are answered. The enumerator should be aware of this and be instructed to adhere to the prescribed wording. The questionnaire should be respondent-friendly and the questions asked must be clear, non-offensive and easy to respond to for the respondent.

18.23 It is essential that the respondent feels free to talk without unnecessary interruptions. Once the interview is proceeding, the respondent should be allowed to talk freely with little prodding from the enumerator. The enumerator should not dominate the interview nor make unnecessary remarks. The interview must be in a warm and cordial atmosphere.

18.24 One of the most important qualities the enumerator should develop is to listen. Listening is a skill which must be learned and practised. Only through proper listening can the enumerator discriminate between what should and should not be recorded.

18.25 Enough time should be allocated for the interview. The time to be allocated for the interview should be sufficient for the respondents to ponder their answers. The respondents should not feel that they are being pressed to complete the interview in a very short time. The enumerator should not cut the interview short because they are under pressure to complete the census of an area in a short period or the interview will be hasty and the respondents may not give complete answers.

18.26 The enumerator should control the interview. Quite often respondents will avoid certain questions by trying to direct the discussion to other topics in the course of the interview. Some questions are necessary and unavoidable on the census questionnaires. The respondents may become tired of responding and need re-stimulation. On other occasions, they may be engaging in irrelevant accounts of how they happened to use a particular rice variety. Raising a well-timed question will put the interview on its proper course.

18.27 Responses should be recorded during the interview. Experience has shown that the only accurate way to reproduce the responses is to record them during the time of the interview. Relevant information will most certainly be lost if recording is left until the interview has been completed.

Objective measurement

18.28 Objective methods may be necessary for some items such as area and yield measurements and physical verification can be applied where the census is conducted by well-trained enumerators. They can also use the method of measuring field dimensions by pacing. Measurements by local weights and measures can be used to estimate production of commodities such as milk, wool and mohair.

18.29 Objective measurement of areas can be done in different ways: (i) by actual measurements in the field or (ii) by using aerial photography or remote sensing imagery. In the past, different methods of actual field measurement were proposed such as rectangulation, triangulation and compass traversing. Rectangulation is still recommended as the simplest if most of the fields are rectangular. In some specific cases, triangulation may also be considered but requires walking inside the field. With the emergence of hand held GPS devices which provide the same level of accuracy as the compass traversing method⁸⁴, the latter method is less and less used. The new method recommended by FAO, is the use of GPS in place of compass traversing method which was very time consuming. Technical guidelines such as xx are being made available on the use of GPS for area measurement. Whatever method is applied, actual field measurements remains time-consuming because each field has to be visited by the enumerators. For this reason measurements are done only on a sampling basis and never by complete enumeration.

18.30 For countries collecting data on yield (not recommended in the essential census data items), objective yield measurements are even more time-consuming and require a visit to the field at the time of the harvest.

Remote data collection methods

18.31 Remote data collection methods are methods which do not require enumerators meeting in person (personal or face-to-face) for interviewing respondents when conducting a census or survey.

18.32 Most developed countries increasingly use some form of remote data collection method jointly with face-to-face method for agricultural census. This method can be adopted, with the expectation of reliable results at substantially lower costs than the interviewer method, in countries where:

- ◆ Literacy is near universal;
- ◆ Educational levels are relatively high; and
- ◆ Communication systems are widespread and efficient
- ◆ Up-to-date address or holding registers exist (countries are increasingly using administrative data to improve their mailing list for self-enumeration).

⁸⁴ Also called rope and compass method

18.33 The self-enumeration method is also conducive to greater involvement of other members of the holder's household in the enumeration process. This is because it encourages consultations among family members, which should yield more accurate and comprehensive information.(UN, 2015)

18.34 In the remote data collection method, the data could be self-reported by respondents using paper or CASI questionnaires. Respondents receive by mail a paper-based questionnaire or a letter with a web secure access code. These methods provide to the respondents instructions on how to complete the questionnaire. Other remote methods gather data from respondents with the assistance of enumerators and interviewers. Prior to the interview, respondents may receive a letter to notify them that an interviewer is going to contact them shortly. During phone interviews, interviewers write the data on paper-based questionnaires or capture the information directly into an electronic questionnaire.

18.35 The following paras explains each remote data collection method and describes some general steps on how to implement them, their advantages, limitations and requirements. The specific methods discussed here are (i) paper-based questionnaire drop-off/mail-back or pick-up by enumerators; (ii) paper-based questionnaire mail-out/mail-back; (iii) paper-based questionnaire for assisted telephone interviews; (iv) electronic questionnaire for computer assisted telephone interviews; and (v) online electronic questionnaire.

Description of remote data collection methods

Drop-off/Mail-back (DO-MB) or Pick-up by enumerators (DO-PKE)

18.36 The drop-off/mail-back requires the national statistical office or mandated data collection agency⁸⁵ to mail paper-based questionnaires to local or field enumerators. The field enumerators deliver the questionnaire to the respondents' residence with instructions on how to complete the questionnaire and how to mail it back once completed in an enclosed postage-paid envelope. Questionnaires could be mailed either to local field enumerators, communes or local governmental organizations, or to the census office.

18.37 Field enumerators or local organizations can also be involved to confirm that a holder resided in the household and to identify new agricultural operations not identified of their assigned enumeration area. Field enumerators can be involved in verifying returned questionnaires for completeness and editing errors. They can follow up with respondents to verify questions failing major edits. They can also assist respondents who phone asking for help or scheduling a meeting in person to complete the questionnaire at the local field enumerator's office or the respondent's residence.

18.38 Field enumerators can follow-up with respondents who have not returned their questionnaire after the collection deadline. Follow-up attempts could consist of a certain number of calls or personal visits. After a pre-determined number of attempts, if there is no response, field enumerators obtain a direct refusal for respondents, or if they are not successful to contact them, enumerators complete a missing questionnaire form to be returned to the central office.

⁸⁵ For simplicity, "national agency" will be used in the rest of the document.

18.39 Field enumerators and local organizations are responsible for returning all questionnaires (completed or not) to the census office after the collection period. Upon reception of questionnaires at the centralized office, they are processed for capture, imaging, automated data capture and further processing for automated edits and imputation, analysis and data tabulation.

18.40 Tracking control procedures are also put in place at different transaction points to follow the flow of questionnaires and ensure that no questionnaire is lost. Several transaction and control points could be established from the printing of questionnaires at the census office to respondents and the return to the census office.

18.41 The drop-off/pick-up method is essentially the same as the drop-off/mail back method except that field enumerators could schedule appointments with respondents to return to their residence to pick-up completed questionnaires. During the pick-up visit, field enumerators may assist respondents to finish completing the questionnaire and verify with them the basic edit rules and quality checks.

Mail-out/Mail-back (MO-MB)

18.42 The mail-out/mail-back method requires the census office to mail paper-based questionnaires directly to respondents with instructions on how to complete the questionnaire and how to mail it back once completed in an enclosed postage-paid envelope. Completed questionnaires are mailed back to the census office.

18.43 A reduced number of field enumerators (compared with previous methods described above) or local organizations can also be involved to identify new agricultural operations not identified in their assigned enumeration area. They can be involved in questionnaire drop-off where street addresses do not exist or in remote areas where it is not possible to identify the dwelling and households to mail census questionnaires. They can also be retained to visit non-responding holding.

18.44 The verification of returned questionnaires for completeness, editing errors, follow-up calls to respondents to verify questions failing major edits, and a help line to assist respondents are activities that are usually centralized in the census office. In a centralized office, questionnaires are processed for capture, imaging, automated data capture and further processing for automated edits and imputation, analysis and data tabulation. There may be high levels of non responses in this method which may increase workload for call back.

Paper Assisted Telephone Interviews (PATI)

18.45 The PATI method requires the census office to have interviewers contacting respondents by phone and to write data on paper-based questionnaires. A notice letter and paper-based questionnaire could be mailed prior to the collection period with instructions on how to complete the questionnaire. This will help respondents to prepare prior to the phone interview. This activity could be centralized in the census office or in communal-local organizations.

18.46 A reduced number of field enumerators can be retained for identifying missing holdings and follow-up visits to non-respondents.

18.47 The verification of questionnaires for completeness, editing errors, follow-up calls to respondents to verify questions failing major edits, and a help line to assist respondents are activities that are usually centralized in the census office. These activities could also be performed in communal-local organizations.

18.48 For efficiency, the census office processes questionnaires for capture, imaging, automated data capture and further processing for automated edits and imputation, analysis and data tabulation. Potential issues may include getting the correct phone number of the holder and the need to explain that the call is indeed from the Census Agency.

Computer Assisted Telephone Interviews (CATI)

18.49 The CATI method is essentially the same as the paper assisted telephone interviews except that interviewers, contacting respondents by phone, enter the data into electronic questionnaires. A notice letter and paper-based questionnaires could be mailed prior to the collection period with instructions on how to complete the questionnaire. This will help respondents to prepare prior to the phone interviews. This activity could be centralized in the census office or in communal-local organizations.

18.50 Other collection activities (identification of missing holdings, follow-up calls) are similar with PATI described above.

18.51 The verification of questionnaires for completeness, and editing errors could be built into the electronic questionnaire, and interviewers can confirm suspicious answers and apply corrections with the help of respondents during the phone interviews. CATI can be conducted in a centralized census office or in communal-local organizations.

18.52 Census office does not need to develop processes to capture questionnaire, image and automatically capture data, since the data is already compiled with the CATI electronic questionnaires.

Computer-Assisted Self-Interviewing (CASI) or Computer Assisted Web Interview (CAWI) with online electronic questionnaire

18.53 The CASI method requires the census office to send census notice to respondents with instructions on how to access the web (online) questionnaires with their secure access code, phone number to call for help and how to complete it online. The secure access code is required to authenticate respondents, allowing them to access

Box 18.2 Comparison for remote data collection methods

Appendix 1 presents the remote data collection methods used in several countries for collecting census of agriculture data. A limited number of countries rely solely on one method. For example, the Netherlands has used only CASI data collection since 2012. Ireland, Luxembourg, New Zealand, Norway and Scotland use only mail-out/mail back. Most countries using remote data collection use more than one methods (starting collection with CASI, moving non-response follow-up into CATI or even CAPI collection to reach respondents that are harder to reach).

The models in Spain and the United States model quite interesting as these country integrate several methods for collecting census of agriculture data. They start with mail-out/mail-back, combined with help line and assistance using CATI. They also offer the option to respondents to complete a web questionnaire. At one point during the collection period, non-response follow-up calls start using CATI. Toward the end, PAPI could start for non-response and special cases that must be collected.

Canada's model use also a multi-method approach. For example, in 2016, an earlier collection start with mail-out/mail back for large and complex holdings. This was followed by an invitation to complete the web questionnaire. Respondents who would prefer to receive a paper-based questionnaire were able to order one. Later in the collection period, interviewers called respondents who have not responded yet using CATI. The CATI application will be the same as the CASI questionnaire.

Frequency of censuses seems also to play an important role. For example, a census of agriculture is conducted every 5 years in Canada and United States, their census programs had a chance to evolve rapidly as new methods are abandoned after being tested or they are maintained and improved after each five year census cycle. Cooperation between Canadian and American Census managers was also beneficial to learn best practices and methods from each other.

the application, and notifying the field collection operation once a questionnaire is transmitted by respondents. It is advisable to develop methods to allow holder to complete the questionnaire on a number of occasions before submitting the questionnaire to the Census Agency. Holders should also be able to re-start completing the questionnaire where they left it if they have to interrupt the process and start again.

18.54 The CASI questionnaire usually includes navigational help information, drop-down menus and online edits similar to the one based on CATI questionnaires. Edits can be simplified in order to reduce respondent frustration with errors and its associated response burden. Skip patterns are built in the CASI questionnaires so only questions related to the type of holding operations are presented to respondents.

18.55 A wave methodology can be developed to mail reminders to respondents to complete the web questionnaire before the allowed deadlines. Subsequent wave letters could be sent to offer other collection methods available (e.g. order a paper-based questionnaire mail-out/mail back, CATI, visit a communal-local office to complete the web questionnaire using their computers). The final notice letter can reinforce the message about respondents' legal obligation to complete the census questionnaire.

18.56 For efficiency, it is preferable that the web questionnaires are also used by CATI and CAPI interviewers once the deadline for respondents to complete their web questionnaire is past.

18.57 A reduced number of field enumerators can be retained for identifying missing holdings and follow-up visits to non-respondents.

18.58 The verification of questionnaires for completeness, editing errors, follow-up calls to respondents to verify questions failing major edits, and a help line to assist respondents are activities that are usually centralized in the census office. These activities could also be performed in communal-local organizations.

18.59 The census office does not need to develop processes to capture, image and automatically capture data since the data is already compiled with the CASI questionnaires.

Strengths and limitations of remote data collection methods and comparison with face to face methods

Each type of remote data collection method has advantages and limitations when comparing to face to face methods. The advantages and limitations also differ between remote data collection methods for some of the aspects of data collection..

Personal contact

18.60 One strength of personal (or face-to-face) interviews by field enumerators is the capacity to establish a direct contact with holders or members of the holding's households. Respondents are more inclined to answer questions from members of their community.

18.61 That direct contact is often lost with remote data collection methods. Some respondents prefer to meet an interviewer in person who takes the time to meet them at their place of work instead of receiving a questionnaire by mail or a phone call. The enumerators are also able to confirm with proper identification they are official census representatives.

18.62 On the other hand, some respondents may view with some degree of suspicion the fact that one of their neighbours has access to personal confidential information. For example, in Canada, the drop-off/mail-back of questionnaires to local census enumerators ended with the 2006 census with increasing public concern over privacy of personal information and the physical security of completed questionnaires.

Identification of new holdings

18.63 In the absence of field enumerators, identification of new and active holdings relies solely on administrative data such as taxation data or mandatory data that must be provided to have access to specific holding registration, regulation or assistance programs.

Timeliness of data collection and processing

18.64 The potential saving of time increases when the data is captured using electronic questionnaires, when local enumerators do not need to perform manual verification for completeness and failed edit errors, and when there is a continuous flow of questionnaires returning to the central collection office for further processing. For example, prior to 2006 in Canada, completed questionnaires were kept for a few weeks in the homes of the field enumerators while they were edited and verified for completeness. The census enumerators' work assignment (or completed questionnaires) could not be delivered to the census office until collection was completed. This situation had the risk of having completed questionnaires being stolen, lost or inadvertently seen by someone other than census enumerators.

18.65 With CATI and CASI methods, completed questionnaires are sent automatically to the census office on a daily basis. The verification of questionnaires for completeness, and editing errors is built into the electronic questionnaires. With CATI, interviewers can confirm suspicious answers and apply corrections with the help of the respondents during the phone interviews. With a CASI questionnaire, respondents are prompted with error messages.

Data quality and coherence

18.66 With CATI and CASI/CAWI, the quality of the data is likely to be superior to methods using paper-based questionnaires. Less time and effort are required for verification follow-up calls with respondents if required, and for post-processing errors associated with data capture (manually or through automated capture using ICR technology).

18.67 The data processing of the questionnaires should also be more coherent as less human intervention is required and edits and imputation are applied according to standardized rules and edits.

Automation of post collection processes

18.68 Remote methods involving paper-based questionnaires require the data to be captured manually or through an automated system. The automated process requires more development costs but often reduce the manual resources to capture the paper-based questionnaires.

18.69 CATI and CASI methods eliminate the need to develop capture systems. They allow the integration of more complex edits applied at an earlier stage in the data collection.

Follow-up for verification and non-response

18.70 CATI and CASI methods require less effort for validation and failed-edit follow-up calls by census office agriculture specialists working on cleaner imputed data. Less calls also means a reduction of response burden.

18.71 Paper-based questionnaire methods often required to delay failed-edit follow-up calls until the questionnaires are returned to the census office to be captured, edited, and to apply automated edit to identify candidates for the failed-edit follow-up calls.

Response burden

18.72 A challenge faced by data collection agencies is the control of response burden and refusal by holders to participate to data collection methods. Holders are targeted by many surveys from different organisations (governmental, non-governmental, academics, companies selling products or services etc).

18.73 With remote methods that do not require direct contact with field enumerators, respondents may opt not to answer a notice to complete web questionnaire or filter calls and ignore incoming calls from CATI interviewers.

18.74 Mail-out or drop-off of printed questionnaires may also discourage respondents from participating if they are perceived to be lengthy and cumbersome documents.

18.75 With a CASI questionnaire, pop-up and links are embedded to provide additional information and instructions and make the navigation as user-friendly as possible. They may only take a few minutes to complete depending of the complexity of the holding operations. Many questions may be skipped as only a few questions may apply to different types of holding operations.

Data collection costs

18.76 Data collection costs of the mail-out/mail-back could be lower compared with the data collection costs of the drop-off/pick-up or mail-back to local enumerators as fewer local interviewers are required. However, savings on local field enumerators, who are often less remunerated than permanent staff in census office, may be offset by higher costs of developing automated capture, CATI and CASI questionnaire systems. When possible, the use of existing CAPI, CASI or automated data capture infrastructure and expertise used in other programmes of the Agency might reduce significantly the cost of migrating to these platforms.

18.77 CATI and CASI questionnaire methods produce paradata which provide information to census managers for developing smart collection strategies, planning level of field enumerator and interviewer

resources needed for different shifts and the adjustment of case loads between different regional offices if the country covers several time zones. Previous cycles paradata as well as paradata from other agriculture survey programs could be used prior to the Census to identify the propensity of certain type of holders in certain areas to respond positively to the Census or to identify when is the best time of the day to contact the holders. The collection strategy could then be better customized using the info from the paradata and then optimize the likelihood of obtaining a completed questionnaire. At the same time, paradata from the Census could provide a gold mine of information for other survey programs.

18.78 Another advantage of these methods is the potential reduction in failed-edit follow-up calls, printing and mailing costs. For example, in 2016, collections costs for the Canadian Census of Agriculture were expected to be reduced by about 8%. Less follow-up will be required due to online edits applied and warnings and verification questions popping up while respondents complete their web questionnaire. A summary of advantages and disadvantages of different remote data collection is presented in Table 18.1.

Table 18.1: Comparison of remote data collection methods

	DO-MB	DO-PKE	MO-MB	PATI	CATI	CASI/CAWI	PAPI	CAPI
Personal contact	*****	*****	n/a	**	**	*	*****	*****
Identification of new and active farms	*****	*****	**	**	**	**	*****	*****
Timeliness of data collection	*	*	**	***	*****	*****	**	**
Timeliness of data processing	*	*	**	***	*****	*****	*****	*****
Data quality and coherence	**	**	*	**	*****	*****	****	*****
Failed-edit follow-up calls	***	***	*****	**	*	*	*	*
Follow-up non-response	**	**	*****	*****	*****	*****	*	*
Response burden	****	****	*****	***	**	*	*	*
Collection cost:								
● field enumerators	*****	*****	**	**	**	**	****	****
● interviewers	n/a	n/a	n/a	*****	*****	**	*	*
● printing	*****	*****	*****	*****	***	*	*****	*
● mail	*****	*****	*****	**	*	*	n/a	n/a
● data capture	*****	*****	*****	****	**	n/a	****	n/a
● failed-edit follow-up	*****	*****	*****	***	*	*	*	*
● failed-edit non-response	**	**	**	****	*****	*****	*	*

Notes: Relative scale from Low (*) to High (*****) High;

Source: Statistics Canada, Agriculture Division 2016

Requirements of remote data collection methods

Respondents abilities

18.79 Remote data collection methods that require field enumerators are likely to be more successful in areas and countries where reaching respondents might be more challenging. Challenges could be the physical access (poor infrastructure) or of human nature (respondents with lower levels of education and literacy). Field enumerators are in a better position to assist respondents in completing questionnaires (either on paper or electronically).

18.80 Another challenge could be the ability of some respondents to use new technology or having some physical impaired capacity. For example, providing answers to an interviewer (CATI or PATI methods) might be difficult for older respondents with hearing problems. Computer and Web literacy or visually impaired respondents might also be discouraged to use CASI. Hearing help devices and video call technology (such as Skype, Facetime Interviews, etc.) may be a solution to offset some of these challenges.

18.81 Access to the assistance from field enumerators will likely continue to play a key role in the success of any remote data collection method.

National infrastructure

18.82 Drop-off/pick-up by (or mail to) field enumerators and mail-out/mail-back methods require a reliable national post infrastructure for mail delivery and reception. In some remote areas, mail get delivered to postal boxes far from the respondent's homes. Many respondents do not pick up their mail on a daily basis. As these methods rely heavily on the national post infrastructure, census managers should plan and have contingencies in case of possible disruption of the service.

18.83 As for the CATI and CASI methods, it is key to have access to a reliable and well developed national telecommunication infrastructure. Some rural remote areas may not have access to high speed Internet. This constraint will likely to become less relevant with the advancement and penetration of mobile phone and broad band communication infrastructure in many countries.

18.84 For CASI, testing the usability should have a higher priority as it is the main component of the collection strategy. It is recommended that in-situ pretesting be conducted using respondents' own computer devices and Internet access.

Comprehensive register of holdings

18.85 All remote data collection methods must have a comprehensive list of addresses and telephone numbers of known holders prior to census day. This list could be established from previous censuses, administrative data and holding organizations. This list must be kept up-to-date to account for new holdings and operations that are no longer farming.

18.86 One challenge with the drop-off/mail-back method is for field enumerators to decide if special arrangements need to be made for large and complex holdings. The identification of these holdings is challenging during door-to-door enumeration and it is preferable to develop special data collection method between census office staff and the managers of these complex holdings.

18.87 Another challenge is to make contact with respondents, as more holders and their spouses have also increased the number of hours worked outside their holding, making a door-to-door contact less likely. Census enumerators are not always able to confirm with certainty that an agriculture census questionnaire is required.

18.88 Linking the Census of Agriculture with the Census of Population is effective for identifying under-coverage as field enumerators are able to quickly deliver a questionnaire to any holding that was not on the initial list. It is also used as a method to eliminate over-coverage. Field enumerators generally know the people in their community and are able to effectively weed out “false-positive” responses to the screening questions and, more importantly, confirm and cancel agriculture questionnaires dropped off by error. For more discussions about linking population and housing census with agricultural census see FAO/UNFPA,- 2011.

Tracking-control document

18.89 Like other data collection methods, all remote data collection methods require the development of an efficient tracking-control document system to ensure that all questionnaires are returned to the census office. No questionnaire can be lost or misplaced.

18.90 For example, in Canada as early as 2006, an automated control system was developed and each paper-based questionnaire was registered using a barcode system. Returned questionnaires (for several reasons such as a change of or wrong address) were tracked to make sure that no questionnaire "escaped" this closed system. The system also tracked the questionnaires as they move from process to the next from mailing, mail-back by respondents/field enumerators to census office reception and further down to data capture. A control system was also useful to determine which holdings required phone follow-up. This signal was triggered by non-response or failed major edit.

Planning

18.91 Regardless of the selected remote data collection method (one method or mix of methods), a census manager must carefully plan the volume of questionnaires that would be expected to be channelled through different methods and post collection processes. Volume estimations are usually based on realistic assumptions, pre-census tests and experiences with past censuses.

18.92 For example, if the collection strategy is to focus first on CASI, and if this option does not meet the targeted volume, this would increase the number of paper-based questionnaires that need to be sent during and after the CASI period is over. More interviewers would be required to conduct non-response follow-up using CATI method as a contingency plan. If the capacity of increasing the number of interviewers is absent, the strategy may change to focus the interviews on selective key questions or group of respondents to expedite the CATI process. This would leave holes in the data set collected, which would require more imputation. Receiving a higher volume of paper-based questionnaires than expected may also affect the quality of the data that would be captured (manually or through automated capture).

18.93 Consequently, data validation would receive more records that are less clean and might require more time for validation, cleanup and analysis. To sum up, these unexpected increases in the volume of questionnaires received by paper or phone would put more strain on staff and existing systems. If

delaying the established production and publication schedules or relaxing measures to produce quality data might not be an option, more resources would need to be allocated in the post data collection processes. Requirements for remote data collection methods are summarised in the Table 18.2.

Table 18.2: Requirements of remote data collection methods

	DO- MB	DO- PKE	MO- MB	PATI	CATI	CASI/ CAWI
Respondents' abilities	**	**	***	***	*****	*****
National infrastructure :						
● mail	*****	**	*****	*	*	*
● telecommunication	*	*	*	*****	*****	*****
Comprehensive farm register	***	***	*****	*****	*****	*****
Training:						
● field enumerators	*****	*****	***	*	*	*
● interviewers	n/a	n/a	n/a	*****	*****	**
Tracking control document	*****	*****	*****	*****	***	***
Planning:						
● human resources	**	**	**	***	***	***
● system development and testing	*	*	*	**	*****	*****
● contingencies	*	*	*	**	*****	*****

Note: Relative scale from Low (*) to High (*****) High;

Source: Statistics Canada, Agriculture Division 2016

18.94 In conclusion, it should be noted that very few countries use only one method. Several factors play a role in the decisions made by census managers in developing the data collection strategy. Among many factors, past census experience, budget, legal framework, complexity and segmentation of the population to interview, and timeliness of producing results play important roles in defining this strategy.

18.95 One element to consider is the reduction of response burden. Offering flexibility of reporting methods to respondents should be part of this strategy to ease the response burden and produce quality data on a timely basis.

18.96 Remote data collection methods may not be within hands reach for many developing countries. Traditional methods with field enumerators using personal interviews with paper-based questionnaires might be the most suitable solution in the short term to collect census of agriculture data in a cost effective and timely manner. Remote collection methods require a reliable infrastructure (national post system, telecommunication, etc.), and limitations in the respondent's abilities may limit the implementation of remote methods for a large segment of the target population of respondents. However, access and deployment of new technologies such as earth observation, GPS, and their diminishing costs may have the potential to make a giant leap forward for the future collection of census of agriculture data in several countries.

USE OF TECHNOLOGY FOR CENSUS DATA COLLECTION

18.97 The technology is moving so fast that there may be technology available by 2020 that are not known or affordable at the time of preparing this publication. Therefore, Census managers should make a trade off between safe proven systems and benefit of using new technology. There are currently technology that can be used in Agricultural census for support to enumerators' work during field operation, for the control, supervision and monitoring, or provide the tools to create a system that integrates enumeration with control and monitoring. The following are the types of technology now available that can be considered for data collection in an Agricultural census:

- ◆ Remote sensing and aerial/orto photos
- ◆ Handheld GPS devices
- ◆ Handheld and mobile digital devices

Remote sensing and aerial photos

18.98 There are five main areas of use of Remote Sensing (RS) and aerial photos for agricultural statistics (Delince, J, 2015):

- ◆ Monitoring Land cover/Land use
- ◆ Area Frame construction
- ◆ Support to field work of censuses/surveys
- ◆ Crop area estimation
- ◆ Crop yield forecasting/monitoring.

18.99 The use of RS and aerial photos for cartography and frame building for agricultural census was discussed in Chapter 12. The following paras will provide an overview on the use of RS for supporting field work and crop area estimation during a census of agriculture. More detailed guidelines on the use of Remote Sensing and aerial photos for agricultural statistics in general, including censuses and surveys can be found in....(Delince J and al, 2017 .upcoming GS publication).

Support to field work

18.100 Whatever the type of frame used (list or area), for the census of agriculture, the enumerator will benefit from the availability of satellite imagery or aerial photos. Satellite images or aerial photos can help the enumerator to optimize his displacements and facilitate localization of holdings and fields. Aerial photos or very high-resolution imagery will help the enumerators to access the land and/or locate the holder. Used as paper prints or on a mobile device, imagery will also minimize the obvious declaration and measurement errors.

Area estimation

18.101 The use of aerial photography for measuring areas of fields during an agricultural census is limited by the fact that agricultural census data are collected from agricultural holdings and the use of RS or aerial photographs implies that each field of a holding covered by the census is identified by the enumerator and the holder on available images or photos. With technological advances, aerial photographs and orto photos are becoming less costly but still require substantial resources to ensure that up-to-date photos are available at the time of the enumerator's visit. Some of the technical issues related to direct use of aerial photos are now being overcome with their transformation into orto-photos using computers (distortions in size of fields on a photo due to difficulties in keeping horizontal flight at a constant altitude and due to uneven terrain). Over the last few decades, ortho-correction algorithms have dramatically improved, which has enabled reductions in cost.

18.102 Two main methods that can be used to derive crop area statistics: (i) Pixel counting and (ii) Calibration methods. But few countries actually use these methods to derive their national crop area statistics. For more information, see from (Delince J, 2015).

18.103 In recent years, the potential use of drones (unmanned aerial vehicles) is being widely discussed. The ortho-rectification and mosaicking technique is sufficiently developed to produce documents with acceptable accuracy, and the dates for image acquisition can be chosen with a flexibility similar to that presented by a field survey. A limitation of drones in many countries comes from flight regulations that often forbid the flight beyond the sight of the operator (GS, 2015 MSF Handbook). Other limitations are the range of coverage limited by the capacity of the battery. This technology may be playing a growing role in the future. **Small low-altitude piloted aircraft** provide images with resolution of approximately 5 cm. They have the advantage of being more frequently authorized to fly long stripes (around 100 km by 100 m) and efficient stripe-based sampling plans can be defined for small aircrafts, especially for the estimation of nomadic livestock

18.104

Hand - held GPS

18.105 The Global Positioning System (GPS) is the oldest and most widely used Global Navigation Satellite System (GNSS). The GNSS are systems based on a network of navigation satellites that is controlled by ground stations on Earth which continuously transmit radio signals – captured by receivers – to determine the receiver’s geolocation (longitude, latitude, and elevation) on the Earth’s surface.

18.106 Generally, a GPS provides support to field activities: geo-referencing plots, holding location; locating reporting holdings the coordinates of which are known; or measuring the area of a plot or landscape patch. The use of GPS in building frames has been discussed in Chapter 12. This section will provide a short overview of its use in support of census data collection.

18.107 Geo-referencing plots, holder’s housing unit or holding headquarters (for non household holdings such as companies etc): When the frame has been defined on the basis of coordinates (possibly in a GIS environment), points with given coordinates in the field must be located. The two main tools for locating a point are ortho-photographic documents and GPS. For each EA, housing units can be identified using GPS coordinates on handheld GPS devices or mobile digital device equipped with GPS. In the case of mobile digital devices, as the holders or holdings to be visited are known, GPS coordinates can be used by a navigation option built for the device to allow enumerators to reach the holder’s house or holding headquarter easily. An extensive elaboration on both the use of GIS and GPS is presented in Chapter III.B and in the Handbook on Geospatial Infrastructure in Support of Census Activities, United Nations, Series F No. 103. More on the use of mobile digital devices in **paragraphs 18.111.**

18.108 Measuring plots with GPS: GPS is very useful to measure the area of single plots on the field. For small fields, at the end of the twentieth century and beginning of the twenty-first century, area measurement with GPS was considered insufficiently accurate. GPS measurements used to be less precise but faster than traditional measurement by tape and compass. In an FAO pilot project, a small negative bias of GPS measurement was observed (Keita and Carfagna, 2009). However, more recent studies (Carletto et al., 2015) strongly suggest that technological advancements in more recent years

with moderate-priced GPS have led to significant improvements even for small plots, especially when signals of more than one satellite constellation can be combined (GPS and GLONASS currently; Galileo and BeiDou should follow). More information on the use of GPS for crop area measurement available in [WB LSMS-ISA publication on the use of GPS](#)⁸⁶.

18.109 GPS as a tool for quality control. In some area frame surveys, surveyors will sometimes make observations from unsuitable points due to location errors or to a certain level of negligence, especially if weather conditions are bad. This type of error can be controlled if surveyors are required to record the point from which the observation is made with a protected GPS device. [\(MSF Handbook\)](#)

18.110 GPS for point location control in objective measurement yield surveys (when this non-essential census data is to be collected). A possible source of bias in yield surveys with objective measurements on a sample of points relates to the determination of the point in which the crop sample will be collected. The traditional approach consists in providing rules on the number of steps that the surveyor should take in certain directions. The movements are determined with the help of a random number table. In some pilot projects (Taylor et al, 1997) it has been observed that surveyors are not very rigorous on applying the rules when their supervisors are not present. The sampling process is more rigorous if coordinates are sampled before the field work and then recorded in the field with a GPS device, with a picture of the location being taken. [\(MSF Handbook\)](#)

Using Mobile devices for Census data collection

Using mobile devices equipped with packages for Computer Assisted Personal Interview (CAPI)⁸⁷

18.111 This is a fast changing area and other new devices are likely to emerge in the decade. Recent years have brought many new mobile devices into the market. Companies such as Apple, Google, Samsung, and many others produce mobile devices of varying sizes, functionalities and prices to meet the demand of consumers. As a result, Computer Assisted Personal Interview (CAPI) applications are being developed to leverage these devices for data collection. The application of CAPI to mobile devices was an important evolution as mobile devices are often cheaper than computers, contain built-in Global Positioning Systems (GPS), and are more portable. Current CAPI applications vary widely in terms of learning curve, features, and cost. It follows that there is not a one size fits all CAPI application or device that can meet the demands of every type of census or survey. A review of current applications with their strength and limitations can be found in (IRIS, 2011)

18.112 Literature comparing the use of Paper-based questionnaires or Paper and Pen Interviews (PAPI) with CAPI applications shows that CAPI can reduce cost, improve data quality, and decrease the time between data collection and analysis. The primary source of cost savings is higher data quality resulting in lower data cleaning cost. Automated crosschecks and strictly enforced skip patterns are common features that dramatically increase data quality.

Box 18.3 Survey Solutions (SuSo)

With the financial support from the Global Strategy to Improve Agricultural and Rural Statistics (GSARS), a free software called Survey Solutions (SuSo) was developed. SuSo is other TAPI/CAPI applications by incorporating an Android tablet application for data capture, user-friendly survey designer which requires no programming knowledge, case management interface tools to monitor field work, and novel export formats such as .dta (STATA), .sav (SPSS), and .tab (tab-delimited). Because of the experience of FAO with SuSo through the GSARS project, the next sections will provide examples of various CAPI features as implemented by SuSo.

⁸⁶ See: <http://documents.worldbank.org/curated/en/257481469116364362/pdf/>

⁸⁷ The term CAPI will be used in the rest of the document even if other electronic devices are used

Additionally, because data is entered directly on the device during the interview, the expense of data entry is eliminated (King, et al. 2013; Liesher 2014).

Questionnaire Design, Data capture, quality check and transmission using CAPI

Questionnaire Design

18.113 Frequently, the most challenging step of implementing a census using CAPI is programming the questionnaire. The amount of programming knowledge required varies widely which directly impacts the long-term sustainability. Additionally, expensive consultants sometimes must be mobilized raising costs and further undermining the sustainability. Some CAPI products are very user-friendly interface do not require knowledge of programming, are more sustainable and are therefore recommended.

Data capture

18.114 CAPI software tools incorporate the **traditional question types** (e.g. single-select, multi-select, numeric, date, text, and list) and some novel question types not available with PAPI. Default keyboards and keypads used by the device's operating system are utilized for data entry of the latter four question types. For single-select, and multi-select questions, the interviewer selects the correct options by touching them on the screen. Additionally, some CAPI applications allow the survey designer to incorporate questions which capture the geo-coordinates of the holdings, take photos, and even scan and record

Box 18.4 Enumerator reports lower respondent burden using CAPI in St. Lucia

St. Lucia has been one of the first countries in the Caribbean to implement surveys using CAPI. During an interview regarding her experience using CAPI a field officer reported that she was able to enter the data faster than on a traditional paper-based questionnaire. Also, not having to carry a paper and pen allowed her follow the respondents around the house during the interview allowing the respondents to complete chores. The combination of shorter interview time, and the lack of interruption of household chores reduces the burden on respondents and improves the rate of response [CSO 2016].

barcodes of items which are present within the holding.

Data Quality

18.115 Common tools such as **skip patterns** used in PAPI are strictly enforced by CAPI eliminating the potential for routing errors through 'enablement conditions'. Enablement conditions are pre-programmed instructions, which activate or deactivate questions based on the answer to a previous question.

18.116 CAPI also provides survey designers with validation conditions which are pre-programmed instructions that anticipate an answer to lie in a certain range. If the validation condition is violated (i.e. an unlikely or impossible response is entered), the interviewer is prompted with a message.

18.117 Use of strictly enforced skip patterns, and validation conditions have been shown to completely eliminate data routing errors, and impossible or unlikely entries (Zhang, et. al 2012; Caeyers, et. al. 2010).

Transmission

18.118 After an interview is completed, the data is transmitted to a centralized database for quality control, compilation, and analysis. The most common ways to transmit the data are over cell phone data and Wi-Fi networks. Use of Wi-Fi networks is practically a universal feature of mobile devices, and some tablet devices offer a slot for a SIM card to access cell phone data networks. Finally, some CAPI applications also offer tools for offline data transmission.

Box 18.5 Transferring data in areas of low connectivity in Tanzania

The Ministry of Livestock and Fisheries Development (MLFD) in Tanzania implemented a baseline survey of veterinary livestock officers using SuSo during July 2015. The enumerators were required to travel to remote areas of three regions to conduct interviews. Accordingly, the MLFD took a few steps to mitigate the risk posed by unreliable connectivity to cell phone networks and internet connectivity. For example, the enumerators were given SIM cards from two different companies providing a wider range of access to cell phone networks. Furthermore, enumerators were trained to wait to transmit the data until they returned to more populated area where cell phone coverage was better. Finally, field supervisors were given back-up paper questions if no coverage could be found. In the end, not a single interview was conducted using the paper-based questionnaire (Rahija and Mtui 2016).

Using mobile devices equipped with GPS for Geo referencing holdings

18.119 Many mobile devices contain Global Positioning Systems (GPS) that use satellites to determine the location of the mobile device. Many CAPI packages integrate this feature into data entry applications allowing the enumerator to capture geo-references during interviews. The accuracy of the geo references depends on the quality of the GPS in the mobile device, satellite coverage and other factors during the interview (Keita, Carfagna et al. 2010).

18.120 If accurate geo-references are obtained, they can be used to optimize logistics through enumerators' navigation and planning transportation, monitor census progress, and provide opportunities to conduct geospatial analysis of the variables obtained.

Mobile devices equipped with GPS for optimizing logistics and supporting enumerators

18.121 Geo-reference information on holdings can be especially useful when enumerators are required to make more than one visit to the holding. Examples of this include:

- ◆ Listing exercise is undertaken and enumerators must return to conduct the interview;
- ◆ Longitudinal surveys;
- ◆ Questionable responses that require follow-up;
- ◆ Agricultural surveys which require pre-harvest and post-harvest visits
- ◆ Agricultural surveys including continuous crops
- ◆ Agricultural censuses using modular approach or integrated census survey modality requiring more than one visit

18.122 Census managers can use the geo-referenced information to create maps using free open-sourced software.

18.123 These maps can be shared with enumerators through mobile devices allowing the enumerator to navigate to the holding. Notably, this can also have the positive effect of minimizing the likelihood of the

enumerator going to the incorrect holding. Finally by using a map, enumerators can plan their best route overall maximizing the efficiency of logistics and reducing data collection time.

Mobile devices with GPS and paradata for monitoring census progress

GPS for monitoring

18.124 A common problem in agricultural censuses are fraudulent interviews and fabricated data. When enumerators are paid based on the number of interviews they conduct, there is an incentive for enumerators to inflate the number of completed interviews by filling in questionnaires with fake information. Accordingly, census managers conduct various quality checks and field supervision to minimize this risk. Requiring enumerators to geo-reference the location of the interviews gives census managers another tool to prevent fabricated data.

18.125 Furthermore, plotting geo-references on a map allows census managers to visualize the progress of their census. As a result, they can see differences between areas of the number of interviews conducted and make better informed decisions.

Paradata for monitoring

18.126 Paradata is information captured about the interview (e.g. date and time of start, completion, approval, etc.) The daily tabulation of this information allows census managers to closely monitor the progress of activities and even detect fraudulent interviews.

18.127 Table 18.3 below shows the start time, end time, and duration of interviews conducted during a day. This table indicates that there is a lot variation in the time takes, but it is clear than an entire interview taking under 30 minutes would be very suspicious.

Box 18.6 Finding the breakeven point of using CAPI or PAPI in Zanzibar

A randomized control trial was conducted in Zanzibar during 2009 to compare the use of CAPI and PAPI. The cost dimension was examined by removing the costs that are common across both CAPI and PAPI (i.e. enumerator training, coordinator salaries, etc.) and comparing what is left over. Accordingly, the fixed cost of conducting a CAPI survey was estimated to be 40,000 USD due to consultancy fees and application development compared with only 4,000 USD for the fixed cost of a PAPI questionnaire.

In contrast, the variable costs of CAPI were 1 USD per questionnaire which is much lower than 10 USD for the PAPI questionnaire. Accordingly, $40,000 + X = 4,000 + 10X$ gives a break-even point of 4,000 questionnaires. Above 4,000 questionnaires, CAPI is clearly the cheaper option if we do not consider that the equipment can be used for other surveys which would lower the fixed cost, and the breakeven point (Caeyers, et. al. 2010).

Table 18.3: Tabulation of paradata for census monitoring

id	Interviewer	Names	Starttime	Endtime	Duration
bbe15	lss_inter9	removed	2015-07-31 08:03:13	2015-07-31 09:11:23	0:1:8:10
c7919	lss_inter16	removed	2015-07-31 10:22:42	2015-07-31 11:44:59	0:1:22:17
96823	lss_inter7	removed	2015-07-31 06:43:32	2015-07-31 07:48:38	0:1:5:6
44a59	lss_inter18	removed	2015-07-31 09:30:29	2015-07-31 10:49:38	0:1:19:9
23ae5	lss_inter4	removed	2015-07-31 11:23:39	2015-07-31 12:25:36	0:1:1:57
a47bf	lss_inter6	removed	2015-07-31 07:53:08	2015-07-31 08:58:18	0:1:5:10
2e4c5	lss_inter10	removed	2015-07-31 08:57:27	2015-07-31 10:20:44	0:1:23:17
98fa9	lss_inter16	removed	2015-07-31 09:06:31	2015-07-31 09:37:21	0:0:30:50
48eea	lss_inter4	removed	2015-07-31 08:30:01	2015-07-31 09:22:14	0:0:52:13
e17b2	lss_inter10	removed	2015-07-31 11:12:52	2015-07-31 12:41:58	0:1:29:6
80157	lss_inter3	removed	2015-07-31 07:54:14	2015-07-31 08:48:19	0:0:54:5

Source: Rahija and Mtui 2016

18.128 Furthermore, paradata can be used to create daily figures showing progress across enumerators and teams. Figure 18.1 clearly shows that Teams A and C are performing the best,

while Team B is lagging behind. It also indicates that interviewer_10 did not perform any interviews.

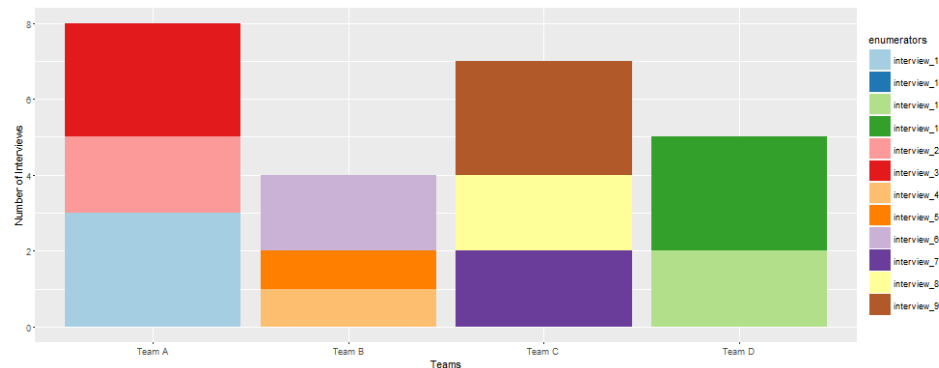


Figure 18.1: Number of interviews conducted by team and interviewer

Note: Based on author's simulation (code available at: <https://github.com/michaelrahija/wcaFigs>)

Safety and security of the enumerator Real time monitoring of field staff can be also very important in contexts where there may be some potential risks for their safety and security may be in danger. Therefore, mobile devices equipped with GPS, by allowing monitoring the geo-location of each field staff can help in addressing security threats.

Limitations of using Mobile devices with CAPI for census data collection

18.129 As mentioned above, censuses and surveys vary widely in terms of size, target population, and variables to be collected. Accordingly, there is not a one-size-fits all CAPI technology that is the best for every single type of census or survey. There are also circumstances in which using a traditional PAPI questionnaire is more appropriate than using CAPI. The main considerations when deciding between PAPI and CAPI should be size and cost, access to cellular data networks and Wi-Fi, and safety and security.

Size and cost

18.130 Use of CAPI for census or survey require the up-front fixed cost of purchasing equipment, and training staff. However, many of the variable costs associated with PAPI such as printing questionnaires, data entry, and data cleaning are completely eliminated (Caeyers, et. al. 2010). Accordingly, as the size increases, the marginal cost of conducting a census using CAPI declines. Additionally, if the CAPI will be used for future censuses or surveys, then fixed costs are spread across multiple data collection operations.

Access to cellular data networks and Wi-Fi

18.131 Though examples of methods to offset the risk of under coverage posed by cellular data networks in remote areas were listed above, there may be circumstances in which the risks posed by lack of coverage are unsurmountable. The transmission of data using CAPI relies upon frequent access to cell phone data networks or Wi-Fi. It may be the case that in certain areas of enumeration, the interviewers go for long periods without access to cell data networks or Wi-Fi. Additionally, mobile device GPS functions sometimes using data networks to improve the accuracy of the geo-referenced information. If cell phone networks are not available, low accuracy of the geo-references may render it unusable. Significant cost increasing measures may be required under these circumstances.

Access to power source

18.132 Power sources may be inexistent in many rural villages in some developing countries which may add a major constraint on the use of CAPI. Back-up batteries and/or solar chargers may be needed adding to the cost of use of CAPI

Safety and Security

18.133 As with planning any census or survey, the safety and security of enumerators should be a major priority of census or survey managers. Enumerators carrying expensive equipment like mobile devices could make them a target for thieves.

Other issues

18.134 In some countries, issues related to culture have been mentioned such as reticence of elder farmers when young enumerators using CAPI are performing interview. Also, there may be a need for frequently updating the device due to rapid advance of the technology

Special problems for data collection

Kitchen gardens and horticulture crops

18.135 Estimation of areas under different crops in small kitchen gardens or similar, such as communal gardens, school gardens, prison holdings, etc., where a single plot grows several vegetables, all sown in separate rows, presents a problem where the subjective method of eye estimation of proportions of areas occupied by the different crops offers a solution. Unless actual crop yield surveys for vegetables are planned in a census operation (which is very expensive), estimation of production of crops in such gardens will have to be based on subjective judgements. This subjective estimate can be verified against the quantity actually harvested from a known area. Such subjective estimation and verification of an estimate can also be applied to fruit orchards for which the use of the objective measurement method is difficult. More information on estimation of horticulture crop area, yield and production to be found in [GS publication... Mix cropping and associated crops in...](#)

18.136 Crops cultivated simultaneously: This is one of the most difficult problems in agricultural statistics in many developing countries, particularly in African countries. Similar to kitchen gardens mentioned above, this refers to two or more different temporary or permanent crops grown simultaneously in the same field or plot. Mixtures of temporary and permanent crops are called crops grown in association with each other. Problems come from the difficulties in allocating area to each constituent crop and estimating production for each crop.

18.137 There are a few cases of crops being cultivated simultaneously which do not represent a major problem. These are some traditional combinations of temporary crops grown and harvested as a mixture in certain countries (e.g., millet and sorghum, mixed grasses grown for hay, etc.). It is best to treat a mixture of this kind as a single crop without attempting to estimate area under each crop. Regarding crops cultivated simultaneously which are harvested separately, there are countries with just a few typical mixtures (e.g., maize and beans) grown in rows. Such mixtures may be shown as a separate crop, and when grown in rows it may be relatively easy to estimate the area under each constituent crop.

18.138 Problems refer to situations when many crops grow together in a very large number of different combinations. However, experience has shown that a limited number (four to five of the most important

crops) should be considered based on their contribution to food security or other criteria. Some important commercial crops, such as chili may have to be omitted as not being the most important crops in the field.

18.139 Various ways of handling this situation have been used by countries. Under the Global Strategy, a research on this topic has produced some relevant technical documents and guideline. Different methods of apportioning area between crops present in a mixture are discussed including eye estimates and various objective methods (predominant, main crop, so-called imputed (theoretical) area, allocated area etc.).

18.140 In the presentation and/or tabulation of these crop areas in the census reports, it would be very useful to present the following four types of area separately for each particular crop (FAO, 1982):

- (i) Total area of the crop in pure stand.
- (ii) Total area of the crop cultivated with others.
- (iii) Total imputed area of the crop.
- (iv) Total allocated area of the crop.

This would permit different types of aggregation, namely:

- (i) + (ii) The total physical area on which the crop is cultivated.
- (i) + (iii) The total area which could be used for calculation of the crop production (multiplying it by average yield in pure stand).
- (i) + (iv) The total land area used for the crop. (14.43)

18.141 For associated crops, the area should be recorded both under the fruit tree (orchard) crop and the ground cultivated crop and it should be specified whether fruit trees are of a bearing or a non-bearing age.

18.142 Continuous harvesting: Root crops such as carrots, beetroots, radishes, turnips, sweet potatoes, green corn cobs, etc., can be harvested continuously from the same field throughout the season. In the case of green beans and green peas, and leafy vegetables such as spinach, continuous harvesting takes place through the season from the same plants. To these can be added cotton, where several pickings are made from the same plants. These are annual field crops which are ploughed up and destroyed at the end of the season. The perennial fruit trees and long duration crops (i.e., sugar cane standing in the field for more than one agricultural year) are also harvested continuously during the season.

18.143 The area of these crops has to be enumerated only once during an agricultural year irrespective of the number of harvestings from the same fields or plants. Estimations of their yield rates for all harvestings during the year have to be included in the production. If crop-cutting surveys are designed to estimate their yield rates (which would be difficult as part of census operations), all the harvestings in sample plots will have to be taken. Perhaps regression equations could be worked out between the yield obtained from the first few harvestings and the total yield.

18.144 In some cases, the continuous harvestings might extend into a succeeding agricultural year. If such extended harvestings cover only a small part of the succeeding year, it will be more practical to include them during the current year. But if the extended harvestings cover a considerable or major part of the succeeding year, they should be included in that year.

18.145 Partial harvesting: This refers to so-called "reserve crops" among which is cassava, an important food crop in some developing countries. This occurs when the crop is planted in a greater quantity than normally required, often as a last crop in the shifting cultivation cycle, before land is returned to bush. Usually, only a part of the potential production is used, harvesting being done when needed over a course of time. Crop production can be assimilated to consumption in a context of self consumption and is very difficult to estimate (14.48). Some guidance to be found in ... WB research

18.146 Scattered fruit trees: The number of fruit trees which are planted along field borders or scattered in fields and in other parts of a holding should be counted separately for each species, classified into those of bearing and non-bearing age. Total production from such trees can be calculated if the estimate of yield per tree is known from yield estimation surveys or by a subjective method of estimation. As yield from a scattered tree is likely to be different to that from a tree in a compact orchard (other things being equal), it is preferable to have a separate estimate of yield from scattered trees. The number of scattered trees of a fruit species can be converted into its area equivalent by applying a normal planting rate.

18.147 Enumeration of outside parcels: All parcels of a selected holding, whether they lie within or outside the selected primary sampling unit must be enumerated under that holding, provided they are not operated as a separate technical unit. It is possible that all parcels of a selected holding may be outside the selected primary sampling unit under a separate operator. Generally, such outside holdings will not be far away, but if so they can be enumerated by the nearest enumerator and the relevant questionnaire passed to the enumerator in charge of the selected holding.

Urban and peri-urban agriculture

18.148 In some countries a significant part of the production of some crops or livestock, particularly fruit and vegetable crops and poultry is done inside or in the surroundings of urban cities by residents of the cities. For vegetable crops, the size of holdings involved is usually small but the crops grown are cash crops with high value. In countries where the threshold for qualifying for inclusion in the census population is based on the area of the holding, these holdings will not usually be captured through the census.

18.149 Regarding livestock on the contrary, holdings in urban cities are usually modern poultry holdings or other high value livestock production systems. In case Urban agriculture is not covered in the census, a relatively important part of livestock sector may be missed.

18.150 A major difficulty is the non-availability of suitable frame for these urban holdings and the potential high cost related to identifying the holdings and building a frame. In countries where this type of agriculture is important, various actions may be considered to capture the related information in a cost-effective way.

18.151 As discussed in Chapter 12 if a population census is conducted shortly before the census of agriculture, an agricultural section may be included to provide information for building the frame for the agricultural census. Since PHC is a conducted through complete enumeration in urban and rural areas, it will generate frame information for urban agriculture which could facilitate its coverage during census of agriculture. Another possible source of frame information for urban and peri urban agriculture could be

from administrative sources, particularly commodity associations or cooperatives where this exist. Such associations keep records of their membership and tend to be active in urban cities. In other cases, urban and peri urban vegetable crops are concentrated in particular zones (such as the borders of rivers or other water points. When recent satellite images or aerial photos are available, area frames may be considered.

18.152 Depending on the country situation, census modality and availability of frame, a specific module or dedicated survey may be considered on urban agriculture or a component such as horticulture crops. The implementation of such module or survey will follow the recommendations provided in previous sections.

Common land and livestock lease

In some communities, some agricultural lands cannot be covered through surveys addressing holdings as defined in the census of agriculture. They may be best covered through appropriate questions in community surveys. Another possibility is to introduce a special category of holding corresponding to common land.

Livestock lease (... Massimo to provide a short para)

Shifting cultivation

18.153 As already stated, in an agricultural census the basic unit is the agricultural holding. However, a system of cultivation exists where holders clear certain parts in the reservoir of natural vegetation (forest or grass-woodland) for a certain time and abandon them when the soil fertility is depleted. This system of cultivation is called "shifting cultivation".

18.154 In such cases the definition of a holding cannot be strictly applied. The total area of the holding should in such cases be considered as the sum of:

- ◆ The area under crops during the reference period of the census, and
- ◆ The area prepared for cultivation but not sown or planted at the time of the enumeration.

18.155 Some cases can also arise where a holding is composed partly of settled agricultural land and partly of shifting cultivation. In such a case each part of the holding should follow its own rules when recording total area. This is particularly frequent in countries (or parts of countries) with a high rural population density.

18.156 Collection and interpretation of data on the extent of shifting cultivation obtained from holders presents some problems, particularly in areas where settled agriculture is found together with shifting cultivation. There are different arrangements under which shifting cultivation can be practised. Most of the shifting cultivation is found under communal land tenure. The community (village, tribe, etc.) has ownership or cultivation rights over land area and is responsible for allocating pieces of land to individual holdings. Another form of shifting cultivation is practised by squatters, i.e., individual holders who are using pieces of land from natural forests and pastures (woods or bush) under circumstances where the rights of land ownership are ill defined or not protected. Shifting cultivation should not be confused with land rotation which, although similar in nature, is restricted to rotation of land owned (or in owner-like possession) by a single holder, while shifting cultivation refers to rotation of communal land or "nobody's" land.

Under the circumstances, it is not practical to ask the agricultural holders whether or not they are practising shifting cultivation, because they may not know any other system. Relevant data proposed to be collected from holders for each parcel are: (i) tenure of land and (ii) number of years under cultivation. Extent of shifting cultivation is then estimated on the basis of these data.

Enumeration of nomadic and semi-nomadic livestock

18.157 Enumeration of nomadic and semi-nomadic livestock presents serious problems in some countries. The Guidelines on enumeration of nomadic and semi-nomadic livestock⁸⁸ published in the framework of the Global Strategy to Improve Agriculture and rural statistics provides detailed discussion and guidance on this subject. The guidelines adopts the following definition of nomadic: 'nomadic and nomadism relate to people who travel from place to place to find fresh pasture for their animals and have no permanent home. Nomads are exclusive livestock producers, who grow no crops and depend solely on the sale or exchange of animals and their products to obtain foodstuffs. Their movements are opportunistic and follow pasture and water resources in a pattern that varies from year to year. This type of nomadism reflects, almost directly, the availability of forage resources; the more patchy these are, the more likely an individual herder is to move in an irregular pattern'.

18.158 The guidelines recognise that various approaches to meeting these challenges have been adopted by different countries, according to local circumstances and requirements, but there still is no generally accepted method of enumeration of nomadic and transhumant livestock.

18.159 It specifies that in general, two types of data collection methods can be used to enumerate nomadic and transhumance livestock: (i) ground surveys and (ii) aerial/satellite surveys.

18.160 Ground surveys are implemented through two main ways. First, animals can be counted on enumeration points which are sites where animals congregate, such as watering points, vaccination points, dip tanks and spray races, but can also include temporary seasonal camps, stock routes and livestock markets. It is also possible in some situations to create specific enumeration points for the purposes of the survey. This method requires a complete list and map of all points of given type in the enumeration area. Each type of enumeration point has its advantages and disadvantages which are discussed in detail in the guidelines.

18.161 Secondly, as in some countries nomadism and transhumance are practiced by some *specific ethnics groups or clans*, livestock enumeration can be done with the support of ethnic group/clan leaders and family networks to locate livestock by identifying and locating temporary seasonal camps of group members. Before using this approach, the following basic conditions have to be fulfilled: have prior agreement and full cooperation of all group members, make a list and map of all camp locations in the enumeration area, and do awareness campaign in advance to explain the purpose.

18.162 Animals can be enumerated by physical inspection of animals in herds and flocks (direct observations), or from the numbers reported by informants (interviews). The first option is the best in order to avoid declaration biases. Enumerators must count animal themselves by using various tools: hand tally or counter (single or multiple counters), photographs, etc. In order to avoid double counting, the counted livestock may be marked and an enumeration certificate may be provided to herders after counting. During the enumeration of large herds, it is very difficult to collect simultaneously data on several variables like species, age, sex or breed. It may be appropriate to have an observer calling out the species, sex and age of each animal seen, and another individual recording the observations. A sample of the herd may also be selected to collect these kinds of data.

⁸⁸ See <http://gsars.org/en/guidelines-for-the-enumeration-of-nomadic-and-semi-nomadic-transhumant-livestock/>

18.163 The second option of enumeration consists in using questionnaires to collect the number of livestock through the herders' declaration. Some issues have to be taken into consideration: recall period should be different from large ruminants (12 months) and small ruminants (6 months), the herder is not always the owner, and herders are sometimes reluctant to provide accurate information on the number of their livestock because of cultural considerations and the fear of taxation or other government policies in some countries. These issues may be sources of important declaration biases. It is thus important to select a sample of herds for a supplementary direct counting of livestock in order to correct these biases.

18.164 Aerial surveys can be implemented in various ways. Low level aerial surveys, which are usually flown at between 300-1,000 feet (100-300 meters) above the ground, are ideally suited for coverage of extensive, remote areas, which are inaccessible by other means. Animals are counted and recorded during flight and photographs are taken of larger herds, for subsequent verification and correction of observer bias. Instead of having teams of people in a low flying aircraft, cameras can be installed that take photographs at regular intervals. But counting animals from photographs requires training and experience to be sure that what is counted is really livestock and that all livestock are recognised as such. Aerial photographs may be used to check the visual counts and to try and determine and correct for observer bias. Drones and micro-drones may represent another way to gather aerial count data without the need for manned flights. They are starting to be used for data collection in relatively remote areas and for things that are difficult to count such as wildlife animals. The use of larger drones for enumerating livestock is not a common practice because they are expensive and need high levels of technical support. More likely to be of use are "micro" or personal drones. These are relatively cheap, small, lightweight, and can be easy to fly. They can be fitted with video or still cameras for livestock enumeration purposes but they are currently limited in the range covered due to limitations in the autonomy of their batteries..

References and suggested readings

Delincé, J. 2015. Cost-Effectiveness of Remote Sensing for Agricultural Statistics in developing and Transition Countries. Global Strategy Technical Report. Global Strategy Publication: Rome

Food and Agriculture Organization of the United Nations (FAO). 1982. Estimation of crop areas and yields in agricultural statistics. FAO economic and social development paper No. 22. Rome: FAO.

FAO 1996. *Conducting Agricultural Censuses and Surveys*. FAO Statistical Development Series n. 6. FAO Publication: Rome

FAO & UNFPA. 2012. *Guidelines for Linking Population and Housing Censuses with Agricultural Censuses: with selected country practices*. FAO Publication: Rome.

FAO Global Strategy, 2015. HANDBOOK ON Master Sampling Frames for Agricultural Statistics- Frame Development, Sample Design and Estimation. Global Strategy Publication: Rome

FAO Global Strategy, 2016. Guidelines on enumeration of Nomadic and Seminomadic Livestock. Global Strategy Publication: Rome

IASRI, 2016. SYNTHESIS OF LITERATURE AND FRAMEWORK- *Research on Improving Methods for Estimating Crop Area, Yield and Production under Mixed, Repeated and Continuous Cropping*. Global Strategy Working Paper No. 5. Rome January 2016

Iglesias, L. 2014. Improving the use of GPS, GIS, and RS for setting up a Master Sampling Frame. Paper prepared for the *FAO Scientific Advisory Committee*. FAO Publication, Rome.

Keita, N. & Gennari, P. 2014. Building a master sampling frame by linking the population and housing census with the agricultural census. *Statistical Journal of the United Nations*, 30(1): 21-27.

New Zealand Statistics, 2013. Census collection methods

UNSD, 2015. Handbook on the Management of Population and Housing Censuses, Revision 2

WIKIPEDIA : https://en.wikipedia.org/wiki/Survey_methodology#Modes_of_data_collection

CAPI

Caeyers, Bet., Neil Chalmers, Joachim De Weedrt. 2010. *A Comparison of CAPI and PAPI through a Randomized Field Experiment*. Social Science Research Network. Accessed at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1756224

Central Statistical Office (CSO). 2016. *The Next Level "Advancements in ICT"*. St. Lucia. Accessed at: [\[insert link when posted\]](#).

Keita, Naman., Elisabetta Carfagna., George Mu'Ammar.[2010]. *Issues and guidelines for the emerging use of GPS and PDAs in agricultural statistics in developing countries*. Conference proceedings from the 5th International Conference on Agricultural Statistics (ICAS V). Accessed at: http://www.fao.org/fileadmin/templates/ess/documents/meetings_and_workshops/ICAS5/PDF/ICASV_2_2_097_Paper_Keita.pdf

Liesher, Craig. 2014. *A Comparison of Tablet-Based and Paper-Based Survey Data Collection in Conservation Projects*. Social Sciences. ISSN 2076-0760.

King JD, Buolamwini J, Cromwell EA, Panfel A, Teferi T, et al. 2013. *A Novel Electronic Data Collection System for Large-Scale Surveys of Neglected*. Tropical Diseases. PLoS ONE 8(9): e74570. doi:10.1371/journal.pone.0074570

IRIS. 2011. *Comparative Assessment of Software Programs for Development of Computer Assisted Personal Interview (CAPI) Applications*. World Bank. Accessed at: <http://siteresources.worldbank.org/INTSURAGRI/Resources/7420178-1294259038276/CAPI.Software.Assessment.Main.Report.pdf> .

Rahija, Michael., Dr. Niwael Mtui. 2016. *Report on Tablet Assisted Personal Interview (TAPI) Implementation by the Ministry of Livestock and Fisheries Development in Tanzania*. Conference proceedings from the annual American Association of Public Opinion Research 2016. Forthcoming.

Zhang, Shuyi., Qiong Wu, et. al. 2012. *Smartphone Versus Pen and Paper Data Collection of Infant Feeding Practices in Rural China*. Journal of Medical Internet Research. ISSN 1438-8871.

DRAFT

CHAPTER 19 DATA PROCESSING

Introduction

19.1 During the last decades, the substantial development in Information and Communication Technology (ICT) and software provides a new environment for census data processing. In this 21st Century, statisticians conducting a census of agriculture have access to a variety of ICT tools that can generate significant efficiency savings and provide timelier data. The increased use of the ICT is of great assistance in rapidly producing accurate census results. In practice, many problems, objective and subjective, occur, leading to major delays in data processing. Some of these problems relate to failures of computer equipment, difficulties in maintenance, power failures, lack of qualified staff, etc. Other problems concern poor organization from lack of experience; for example, although computers can quickly tabulate large amounts of data, data entry and error checking present different kinds of problems.

19.2 The ICT strategy for the census should be part of the overall agricultural census strategy, it depends strongly on the data collection option and modality of census taking chosen. The decision needs to be taken at early stage to allow sufficient time for testing and implementing the data processing system. The proper choice of appropriate hardware requires knowledgeable input. The use of hand-held devices for direct entry by enumerators in the field as well as of administrative data to replace partly the data collection are becoming practical in many countries. On the other hand the lower cost of electronic data storage, plus increasing availability of suitable software and trained computer experts contribute to smoother data processing of agricultural censuses.

19.3 With respect to data processing, it would be useful to make an analysis of ICT solutions and data management strategies in terms of hardware and software used in a recent population and housing census or large surveys. This should be used to develop data processing methods and procedures for the agricultural census.

19.4 The following key management issues need to be addressed⁸⁹ in the ICT strategy for the agricultural census:

- ◆ Strategic directions for the census program, often related to timeliness and cost;
- ◆ Existing technology infrastructure;
- ◆ Level of technical support available;
- ◆ Capacity of census agency staff;
- ◆ Technologies used in previous censuses;
- ◆ Establishing the viability of the technology;
- ◆ Cost-benefit;

Few countries use the option to outsource processing activities, however this practice is not common for the agricultural census mainly due to confidentiality issues.

⁸⁹ Handbook on the Management of P&H censuses, rev. 2

Hardware

19.5 When considering hardware requirements, the main characteristics of agricultural census data processing should be kept in mind. These are: (i) large amounts of data to be entered in a short time with multi-users and parallel processing mode of servers; (ii) large amounts of data storage required; (iii) relatively simple transactions; (iv) relatively large numbers of tables to be prepared; and (v) extensive use of raw data files which need to be used simultaneously. The method of data capture chosen by the census office will also have an impact on the hardware required to process census data.

19.6 Basic hardware equipment consists, therefore, of many data entry devices (PCs, hand-held devices, depending on data collection mode) and a central processor/server and networks. Fast, high-resolution graphics printers capable of producing tables and maps ready for distribution are also required.

19.7 It is important to realize that networks require substantial maintenance (trained staff and specialized hardware) and technical support for both hardware and software, involving also organizational and security issues. It is imperative that network problems do not prevent continued (although perhaps limited) processing of the data.

19.8 When designing the hardware system it is necessary to take measures against a potential loss of data or delays in data processing due to power failure or other reasons. A secondary power generator ensuring a continuous and stable source of electricity and advanced back-up systems would be needed, and a security system of the storage devices must be maintained.

19.9 When estimating the hardware requirements the most important factors to be kept in mind in agricultural censuses are the method of data collection and the amount of data collected because of the time involved in data entry and verification. It is important, therefore, to estimate the number of data entry stations (PC and/or hand-held devices) required for this operation and the physical space required for data capture.

19.10 As a general rule, the more advanced the data capture technology, the less physical space required for the processing operation. For example, multiple locations may be required if census data are captured and coded in a paper-based personal interview census (PAPI). This process requires hiring a large number of staff to complete the task. On the other hand, less data capture staff and processing centers will be required if census data is captured using CAPI or through the internet. In this instance, a number of tasks, such as coding and capturing data, are completed in parallel with the data collection.

19.11 In case of PAPI data collection mode, an estimation of the number of data entry stations in the census office can be done based on an estimated number of keystrokes per census questionnaire, or measuring time required for entering data from test questionnaires obtained as part of a pre-test or pilot census. The number of required data entry stations will also depend on the time planned to complete the whole data entry operation. An example of such calculations is shown in the Box. In case of CAPI the number of necessary portable devices (tablets) is calculated on the basis of the number of enumerators.

If t is the time (in minutes) required to enter data from a questionnaire, the number of questionnaires that can be entered in a month using one station is:

$$Q = (6 \times 1 \times 20) \times 60 / t, \text{ or}$$

$$Q = 7200 / t,$$

Assuming respectively: 6 working hours per shift, 1 shift a day and 20 working days a month.

The number of stations (S) required to enter N questionnaires in M months will then be:

$$S = N / (M \times Q).$$

With the above assumptions, in a country where data entry is planned to be completed in 6 months ($M=6$) and 10 minutes are required to enter data from one questionnaire ($t=10$); for 100,000 questionnaires ($N=100,000$) one can calculate:

$$Q = 720 \text{ and } S = 100000 / (6 \times 720), \text{ or}$$

$$S = 23.$$

That is, 23 stations are needed for data entry only.

Box 19.3 Calculation of the Number of Data Entry Stations for PAPI

19.12 When estimating the required number of PCs it should be kept in mind that many of them will be applied to uses other than data collection: verification of data entry (often 100 percent verification is done in the beginning), correction of data errors discovered, programming and testing programs, etc. Also, possible delays because of power failures, organizational problems, human errors, etc., should be taken into account. These problems, as a rule, are much greater than expected.

Software

19.13 As explained in more details in the following sections, the main tasks of software in census data processing are: (i) data entry, (ii) checking data for consistency, (iii) automatic data correction (when

applied), (iv) handling data files (sorting, checking for duplicates, direct access, etc.), (v) data tabulation and (vi) graphic presentation of data and mapping of census results. In the case of sample enumeration, data have to be extrapolated and software for calculating sampling errors is required.

19.14 Improvements and changes in computer hardware/peripherals, including significant advances in reducing both the physical size and cost of storage, have had a major impact on the development of all software and especially of data base and statistical analysis software. Given this wide range of hardware and software, and rapid changes in this area, it is not realistic to expect that one type of hardware and one type of software will serve for many years. As hardware and software are upgraded it becomes necessary to ensure that data can be moved from one software to another (data files are portable). Thus, it is usually preferable to use standard software which are maintained by the manufacturer and for which documentation is easy to find and the experts with wide experience are available. Portability of data files is important, not only within the census office but also to be able to provide data in a computer readable form to external users (See Chapter 20).

19.15 Given all these considerations, it is not appropriate or possible for FAO to make any specific software recommendations. However, it can be said that the use of advanced technology can expedite the processing and dissemination of agricultural census data.

Testing computer programmes

19.16 Considerable time is required to write computer programmes for error identification, automatic error correction (if applied), tabulation, calculation of sampling errors (when sampling is used), etc., using available software. The computer programmes prepared should be tested with data from pretests or pilot census. Questionnaires used in the main data collection operation are likely to differ from questionnaires used for pretesting; in such a case, data on questionnaires referring to holdings enumerated in the pretest must be transferred to the census questionnaires. It may also be necessary to enter estimates on the census questionnaires for items not included in the pretest, as well as erroneous data designed to test the full range of error detection specified for the computer programmes. Computer printouts should list identified errors and corrections. Corrections should also be reviewed to determine whether all errors have been detected. If they have not been detected, additional specifications are required to correct the remaining errors or inconsistencies.

19.17 Computer programmes should be tested, normally by verifying results of both error detection and tabulations for a group of 100-500 questionnaires. Data used for such tests should be tabulated manually to check each item or its classification in the tabulations. Manual tabulation of 100-500 questionnaires is a time-consuming operation and requires qualified staff. When such staff are not available, the number of questionnaires used for testing may be reduced. In any case, it is best to conduct an initial test using questionnaires with artificial data in an attempt to cover all items in as few questionnaires as possible. If the data are well prepared, only 20-50 questionnaires may be sufficient for the first test. Pilot census gives a good opportunity for final and comprehensive test of the computer systems and programmes, including the data transfer (in case of CAPI, CATI and CASI). (see Chapter 17)

Data processing activities

19.18 The main activities in data processing in general are as follows:

- ◆ Data coding and entry
- ◆ Data Editing

- ◆ Validation and tabulation,
- ◆ Calculation of sampling error and additional data analysis.

19.19 These activities are closely interrelated and must be coordinated within a well-planned timetable. Sufficient documentation must be prepared to enable everyone to understand the specific steps to be undertaken. Cooperation between the computer processing unit and the methodological unit within the Census office is important to reduce the possibilities of misunderstanding and to clarify any issues which may arise.

19.20 Countries where provincial offices are involved in the processing will have some of the activities listed above completed in the provincial offices. Provincial offices need to establish a control system to ensure receipt of questionnaires from every enumeration area. Generally, if there is a provincial office system, the provincial offices will also carry out the functions ensuring the completion of the enumeration process and the questionnaires. Provincial offices will reduce the processing workload of the central office and are better suited to undertake the checking of questionnaires as they are more familiar with the respondents. The central office will need to be prepared to track and verify the processing completed in the provincial offices and will have to provide technical assistance (instructions, software, hardware, training, etc.).

19.21 When other modes of data collection are used, such as CAPI or CASI, the activities related to monitoring questionnaires and data entry as well as part of computer editing and coding are done during the enumeration (see Chapter 18).

Data coding and entry

19.22 Coding refers to the operation where original information from the paper-based questionnaire, as recorded by enumerators, is replaced by a numerical code required for processing. Typical examples are when names of crops, livestock, farm machinery, activities, etc., are replaced by a unique number (code) or when data expressed in local units are converted to a standard unit. As manual coding entails a lot of errors it is preferable to use fully pre-coded questionnaires, when possible, for example for the list of crops and types and categories of livestock.

19.23 Computer coding (or precoding) refers to assigning special codes to important classes of data, such as size class codes (codes 1,2,3,...) for consecutive non-overlapping classes. An advantage of computer-assisted coding is that more coding rules can be incorporated into the system to guide the processors through several processing steps, which results in higher quality data.

Data entry methods

19.24 Data entry is one of the greatest time and resource consuming phases of data processing. Data entry methods include the following⁹⁰:

- ◆ Manual;

⁹⁰ Handbook on the management of population and housing census (UN, 2016)

- ◆ Optical scanning;
- ◆ Handheld device;
- ◆ Internet and computer-assisted telephone interviews (CASI and CATI).

19.25 Each method has different advantages, costs and impacts on hardware and software requirements at both data capture and processing. A complete census data capture system may contain a combination of more than one of the above.

Manual data entry

19.26 Manual data entry is a time-consuming operation subject to human error. In this method the clerks manually enter every response from the census questionnaires into computers. Data for the whole questionnaire are entered into databases using data-capture interfaces which simulates parts of the questionnaire on the PC monitor. This method requires staff with ICT skills to set-up a large computer network and all associated responsibilities with supporting a large number of computer users. The software systems and computing hardware utilized for manual data entry are typically fairly simple. However, this method does require many more staff than do the automated data entry systems and is likely to take a longer time to complete. The decision to use manual entry versus automated entry is partly based on timetable requirements, the size of the census population and the cost.

19.27 The speed of data entry in ideal cases is considered to be 8000 keystrokes/hour but it may be much less if the questionnaire is not designed for rapid data entry. In particular, interactive editing may slow the speed of data entry. It is recommended that data entry be 100 percent verified for agricultural censuses based on a small sample of holdings. Verification should be done by a data entry clerk who alternatively changes from data entry to verification of other operators but who did not do the original data entry of the data subject to verification. Experience shows that when a second data entry clerk is just a verifier who reviews/corrects the work done by the first data entry clerk, the verifier tends to agree with what has already been completed. This second method of verification should be avoided whenever possible.

19.28 In the case of censuses, complete verification of each data entry clerk should be done at the beginning of data entry process, not only to identify errors but to identify clerks with low performance. Subsequent verification on a sample basis may be sufficient to monitor the performance. One-hundred percent verification may be reintroduced for clerks failing to maintain an adequate standard of work. Verification could be reduced as performance improves, but a sample verification at some level should continue for all data entry clerks.

Optical scanning

19.29 One alternative is to use automatic reading devices which are capable of scanning human-recorded documents and reading them into the computer directly without keying. Basically, there are two kinds of optical readers:

- ◆ optical/intelligent character readers (O/ICR) and (ii) optical mark readers (OMR).
- ◆ optical/intelligent character readers (O/ICR) are capable to read numbers or letters written by hand on a strictly predetermined position on the questionnaire.

19.30 An O/ICR solution can be expected to provide the following advantages⁹¹:

- ◆ Savings are made in salaries owing to the reduced number of staff needed to code responses, as a proportion of the recognized handwritten responses can be automatically coded without any human input;
- ◆ Additional savings are possible through the efficiencies gained by using electronic images rather than physical forms. These include savings from not having to physically move forms, and the increase in production that is possible from coding staff referring to images rather than physical forms;
- ◆ Automatic coding will provide improvements in data quality, as consistent treatment of identical responses is guaranteed;
- ◆ Processing time can be reduced owing to the automated nature of the process. This can lead to a significant reduction in time for census results to be released to users and thus contribute to an important component of data quality (i.e., timeliness);
- ◆ Form design does not need to be as stringent as that required for optical mark recognition (OMR);
- ◆ Enables digital filing of forms resulting in efficiency of storage and retrieval of forms for future use.

19.31 The disadvantages associated with an O/ICR solution are as follows:

- ◆ Higher costs of equipment owing to the sophisticated hardware and software required;
- ◆ Character substitution, which can affect data quality. This is where the recognition engine returns a value for a character that is not the same as the response on the form.
- ◆ The tuning of recognition engine and process to accurately recognize characters is critical with trade-offs between quality and cost.
- ◆ Handwritten responses must be written in a constrained response area and be recognizable by the I/OCR software;

Optical mark readers (OMR) which can recognize marks made by a special pencil on numbers or letters pre-printed on very special questionnaires.

19.32 The advantages of OMR include the following:

- ◆ The capture of tick-box responses is much faster than manual entry. Typically, OMR machines will read, on average, 7,000 A4 pages per hour;
- ◆ Equipment is reasonably inexpensive;
- ◆ It is relatively simple to install and run;
- ◆ It is a well-established technology that has been used for a number of years in many countries.

19.33 Disadvantages of OMR include the following:

- ◆ Precision required in the printing process of questionnaires;
- ◆ Restrictions on the type of paper and ink that can be used;
- ◆ Precision required in cutting of sheets;
- ◆ Restrictions as to form design;
- ◆ Requirement that response boxes be correctly marked with appropriate pen or pencil.

⁹¹ Paragraphs 19.38 to 19.41 are taken from Handbook on the management of population and housing census, Part V Data processing, Chapter E Technology issues for processing, section 3 Data capture methods.

Hand-held devices

19.34 Another approach used to speed up data-entry concerns the use of CAPI (using hand-held devices such as tablets, portable computers, etc.) with electronic questionnaires instead of paper questionnaires with data entry completed directly by the enumerators (see section 4.2.1 Census data collection). This method is increasingly used and proves to be cost-effective. With this methodology, the census form is programmed in a data entry application, replacing the paper form with a series of sequential questions appearing on the screen of the device. The enumerator reads the questions as they appear on the screen and enters the response by either selecting a pre-defined response or entering a value. This enables simultaneous automatic coding of the responses.

19.35 Skip patterns in the data-entry application loaded onto the handheld device can be programmed, guiding the enumerator through the questionnaire. For instance, if data are being collected for a holding without livestock, the data entry application can be programmed to automatically skip questions that are not applicable, such as breakdown of livestock by sex and age of animals. While this provides the census office the ability to better guide enumerators through the questionnaire, it can also lead to problems if the data-entry program is not thoroughly tested and erroneously skips questions or sections. Then the enumerator will not be prompted to ask the questions and the census will be unable to produce some indicators.

19.36 Thorough testing of the data-entry application is key for the success of the operation. Testing must include both functional testing (testing for correctness) and usability testing (testing that a typical enumerator finds the application easy to use). In addition, field testing, particularly of the data transfer parts of the system, is required.

CASI and CATI data entry

19.37 The use of internet and computer-assisted telephone interviews (CASI and CATI) for census is usually administered in conjunction with other methods. Capturing census data by using CASI or CATI is similar to handheld data collection in that the online form is usually not the exact downloadable version of the paper-based form. Rather, it is an application that guides the respondent through the questionnaire. It is common for the questions to appear either a page at a time or be sequential.

19.38 Testing the flow and skip patterns of the online form is essential in ensuring an intuitive and efficient user experience. The census agency's data processing team should conduct multiple tests to study how the general public will respond to the online form and make the necessary adjustments prior to the actual census.

Table 19.1. Examples of Data scanning and computer assisted systems use for 2010 round of agricultural censuses

TECHNOLOGY	Country
Optical character recognition (OCR)	Malawi, Albania, Czech Republic, Greece, Ireland, Norway, Sweden, Philippines
Intelligent character recognition (ICR)	Tanzania, Canada, Cook Island
CAPI	Mozambique, French Guyana, Martinique, Venezuela, Thailand, Argentina, France, Finland, Lithuania, Colombia, Venezuela, Jordan, Slovenia, Cote d'Ivoire
PDA	Mexico, Brazil
CAWI, CATI, CAPI combined	Finland, Iceland, Estonia, Italy, Sweden, Latvia, Poland, Spain

Source: FAO, Metadata reports; <http://www.fao.org/economic/ess/ess-wca/en/>

Data editing

19.39 Data editing is defined as the process involving the review and adjustment of collected census data. The purpose is to control the quality of the collected data⁹². Editing involves revising or correcting the entries from the questionnaires. The effect of editing questionnaires is (i) to achieve consistency within the data and consistency within the tabulations (within and between tables) and (ii) to detect and verify, correct or eliminate outliers, since extreme values are major contributors to errors in summaries (major errors in data, when sample expansion factors are applied, contribute to incorrect results).

19.40 It is important that the census office form a team responsible for developing the editing rules and programs. This team should comprise of census managers, subject matter specialists and data processors. The subject matter specialists will develop the edit and imputation rules or specifications, which detail the consistency rules and corrective measures. These specifications will then be provided to the data processing staff, who will program the rules in an editing software package. Having continuous communication between the team members is essential in ensuring the editing process is fast, efficient and comprehensive⁹³. The editing rules are formulated on the basis of the questionnaire and represents logical links between the variables. Instructions for editing should be included in the supervisors' manual. It is important to prepare a detailed manual for editing, and to describe exactly how the procedures are applied. This manual should be tested during the pilot census.

Manual data editing

19.41 An important function of manual editing is to verify that completed questionnaires properly identify the holding as an agricultural holding meeting minimum requirements such as size of holding or livestock, as defined for a specific census. Another important feature is to check the completeness of the questionnaire and thus to minimise the non-response. Manual editing (when using PAPI) should begin as

⁹² An introduction to the data editing process, Dania Ferguson, USDA, NASS; <http://www.unece.org/fileadmin/DAM/stats/publications/editing/SDE1chA.pdf>

⁹³ Handbook on the management of population and housing census (UN, 2016)

soon as possible after data collection and as close to the source of the data as possible, such as in provincial, district or lower level offices. Faulty or incomplete questionnaires can be sent back to the field, or corrected in the office on the basis of instructions given to the editing personnel (e.g., using averages from the province or data from neighbouring holdings).

19.42 The errors, which might be discovered through internal and external consistency checks, may be response errors; they may also result from recording the replies in the wrong place on the questionnaire or from faulty and illegible handwriting. It should be kept in mind that a big part of the "errors" detected during data entry when PAPI is used occur because of illegible handwriting.

19.43 During manual editing it is beneficial to conduct a random review of the checking and coding operations because many "editors" develop a pattern for correcting errors and for interpreting difficult-to-read hand-written responses. Although some kind of bias may be introduced by these "editors", it is also important that the corrections be done consistently.

19.44 It should be noted that manual editing may have some advantages. For example, manual editing can identify paper-based questionnaires which should have been returned for completion and initiate follow-up action. Similarly, with a quick review of the questionnaires, supervisory enumerators can detect poor enumeration and inconsistent responses and take corrective action.

Automated data editing

19.45 While some editing operations involve manual corrections, which are corrections made manually on paper-based questionnaires in the office, the majority of editing involves electronic corrections of digital data. This is primarily for two reasons. First, the size of the census operation makes manual editing economically unfeasible. Second, utilizing computers for census data editing removes human error and ensures consistent application of editing specifications⁹⁴.

19.46 When manual editing is followed by automatic editing, the two phases should be coordinated so that advantages of each are fully utilized and, above all, staff responsible for computer editing should know the exact rules for manual editing to avoid possible contradictions and the introduction of personal bias. For example, irrigated land which is not cropped may exist in countries where pastures are sometimes irrigated. Statisticians preparing instructions for computer editing should, therefore, know exactly what kind of manual editing is to be done and how. Since the computer has the capability to implement instructions quickly, completely, consistently and accurately, some of the functions of editing, such as imputation of missing entries, if implemented, or conversion from local units to standard units should be entrusted to computers rather than to manual editing.

19.47 The automatic editing is an important and is an efficient editing approach for censuses, in terms of costs, required resources and processing time. Automatic editing is checking the general credibility of the digital data with respect to (i) missing data, (ii) range tests, and (iii) logical and/or numerical consistency. Examples could be: (i) non-response (e.g., age of the holder not reported); (ii) improbable or impossible entries (e.g., age of the holder is less than 15 years); (iii) internal inconsistencies (e.g., wheat production

⁹⁴ Handbook on the management of population and housing census (UN, 2016)

reported but area not reported, sum of pigs under different categories is not equal to total pigs). In many cases these errors occur because of the failure to define the terms completely, or because the enumerators have not had sufficient training to detect incomplete information. And, of course, it is possible that the errors were created during the data-entry phase.

19.48 Automatic editing can be done in two ways: (i) interactively at the data entry stage, or (ii) using batch processing, or some combination of both.

19.49 Interactive data editing immediately prompt error messages on the screen and/or may reject the data unless they are corrected. This process is very useful in the case of simple mistakes such as keying errors, but may greatly slow down the data entry process in the case of errors which require consultation with supervisors. Interactive editing at the data entry stage is aimed mainly at discovering errors made in data entry, while more difficult cases, such as non-response, are left for a separate automatic editing operation. Interactive data editing is used also with CAPI, CATI or CASI data collection methods. The data entry applications contain programmed checks, preventing some of the errors at the stage of the data collection which is simultaneous with the data capture. The advantage being that the correction is made immediately, it is not necessary to contact the respondent again later.

19.50 Batch data editing occurs after data entry and consists of a review of many questionnaires in one batch. The result is usually a file with error messages. As the editing procedure starts after the data entry, this method can be used with all data collection modes. It can re-check the consistency of the questionnaires or include more control rules than those integrated in the computer assisted data capture application when CAPI, CATI or CASI are used.

19.51 In automatic editing procedure errors can be split into 2 categories: critical and non-critical. Critical errors needs to be corrected, they could even block further processing or data capture (for CAPI, CATI and CASI). In general, the number of critical errors should be limited to few very serious errors (for example, agricultural area of the holding is declared equal to 0 but the area of cassava is greater than 0), blocking should be minimised during the development of the software. Non-critical errors produce invalid or inconsistent results without interrupting the flow of subsequent processing phases. As many of non-critical errors as possible should be corrected but avoiding over-editing. Over-editing may increase the time required to disseminate results, increase costs, distort true values and not necessarily add value to the final product. A general rule of editing is to take a minimalist approach by editing only obvious respondent or interviewer mistakes and responses that are clearly out of range.

19.52 Data editing (data detection) may be applied at several levels⁹⁵:

- ◆ At item level, which is usually called “range checking”. Data are checked on the basis of a possible range, for example “age” must be greater than 0 and less than 120.
- ◆ At questionnaire level, where the checks are done across related items of the questionnaire, for example, the total area must be equal to the sum of the different area categories.
- ◆ Hierarchical that involves checking items in related sub- questionnaires.

⁹⁵ An introduction to the data editing process, Dania Ferguson, USDA, NASS;
<http://www.unece.org/fileadmin/DAM/stats/publications/editing/SDE1chA.pdf>

19.53 Across questionnaires, that involves calculation of valid ranges for each item from the survey data distributions or from historic data for use in outlier detection.

Imputation

19.54 Some detected errors cannot be corrected without re-interviewing the holder. When returning questionnaires to the field is not possible, a remedy (imputation) is available which consists of correcting inconsistent data or providing missing entries on the basis of knowledge available in the office. These inserted values may be averages for groups of holdings with similar characteristics, or may be logical conclusions based on other information available (e.g., missing age of the holder may be estimated from information on the age of his/her children). Missing data for a typical agricultural holding can be copied from another similar holding, without major effects on final results.

19.55 Imputation is the process of addressing the missing, invalid or inconsistent responses identified during editing. This process involves altering one or more responses or missing values for the holding to ensure that the data are plausible and internally coherent. Whenever imputation is used, a flag should be set so that analysts are able to distinguish between reported information and that imputed by the editing system. Two imputation techniques are commonly used (a) cold-deck imputation (static look-up tables) and (b) hot-deck imputation (dynamic look-up tables) (see **Box 19.3**).

19.56 Whichever method is used, data correction or imputation, it is a delicate procedure difficult to implement. Imputation can be done manually or automatically by computer. Generally, manual corrections are recommended for small sample surveys, particularly in developing countries. Manual imputations generally involve consulting the questionnaire for some additional information which may be useful, or simply modifying a keying error that has been discovered, often due to illegible handwriting in paper-based questionnaires. One of the problems with manual imputations is in the repetition of the editing process. Typically, many computer runs may be required before all errors are eliminated (e.g., out of, say, 800 errors discovered in a province during the first edit check, only 600 may be successfully corrected and 50 new ones made so that during the second edit check, 250 errors are detected, and so on). Furthermore, in order to avoid repeated edit checks of "good" records, they should be either stored separately, or flagged; some organizational problems may be created in either case.

19.57 Some of the above problems can be avoided by using automatic imputation. However, this operation is very delicate and may change the values of the original data considerably. Some surveys have been ruined because programming errors have spoiled the data. Previous versions of the data files should be kept before starting any automated editing.

19.58 The philosophy of automatic editing and imputation may consider the following aspects: (i) the immediate goal in an agricultural census is to collect data of good quality. If only a few errors are discovered, any method of correcting them may be considered satisfactory; (ii) it is important to keep a record of the number of errors discovered and the corrective action (by kind of correction); (iii) non-response can always be tabulated as such in a separate column. The data user, however, is generally less qualified than the statistician to guess what non-response means (say age of holder not reported) and prefers not to see this category; and (iv) redundancy of information collected in the questionnaire is very useful to help detect response error and quality of data in general. For example, if data are collected on total number of pigs classified by age: under three months and three months and over, this is redundant information (which may result in $5=2+2$). It is difficult to correct these data unless the holding is visited again or data entry errors are discovered. Too much redundancy may, however, slow data processing considerably. It is considered, therefore, that a reasonable amount of redundancy of data, particularly for important data is useful, but when there is too much redundant data some may have to be ignored.

19.59 After the editing of data, in cases where sampling is used, weights are calculated and assigned for unit data records according to the sampling methodology used. These weights are used to “gross-up” sample survey results to make them representative of the target population, or to adjust for non-response in total enumerations. Aggregate data and population totals from micro-data includes summing data for records sharing certain characteristics, determining measures of average and dispersion.

"Cold-deck" and "hot-deck" are the names of two common procedures of imputation for missing or wrong values.

The "Cold-deck" imputation consists of having pre-selected data for typical agricultural holdings, for each administrative area, and copying these data to replace non-response or the response is imputed on a proportional basis from a distribution of valid responses. Cold-deck imputation uses a pre-stored look up table, which is often derived from reliable data from previous censuses, surveys or other sources, to impute missing values

The "Hot-deck" procedure consists of using data from a recently processed holding with similar characteristics instead of using data from pre-selected holdings. It involves searching through the census records until a similar record is found that does not have a comparable inconsistency. The values from the field in that record are then copied to the record with the missing value.

"Cold-deck" is obviously easier to implement but requires that the choice of replacement values should be perfect in order not to bias the data and artificially minimize the variability (particularly in case of intensive use). "Hot-deck" avoids this risk because it uses existing data but is a more complex method.

In any case, counts should be kept of the number of accesses to each procedure, by areas, regions, etc., and these numbers should remain within reasonable limits.

Box 19.3 Methods of Imputation

19.60 All data items should be checked for consistency and accuracy for all categories at different levels of geographic aggregation. As validation should run parallel to the other processes, it should begin with the first enumeration areas that complete processing, and continue with larger geographic aggregations of data as they become available for validation. These aggregations will eventually comprise entire geographic regions, as defined for the country (e.g., regions or provinces). This ensures that data are checked a number of times, and for larger populations. This is essential as small populations may not fill all cells in a table. This process of check at aggregated level is also called macro-edit. The objectives are to edit data at the aggregate level, and trace inconsistencies at the aggregate level to individual questionnaires. Macro-edits focus the analysis on those errors which have impact on published data.

19.61 Where possible, it is beneficial if data items in both census data and recent surveys can be compared. This is particularly important if the comparable data items have been collected in a recent survey or are available from administrative data sources. This can give indications of expected changes, or provide an explanation of changes or movements detected in the census data. When validating intercensal change between current and previous census data, it is useful to specify tolerance levels for changes in the data items.

19.62 Validating the data before it leaves the processing centre ensures that errors that are significant and considered important can be corrected in the final file. This final file can then be used as the source database for the production of all dissemination products. It is important that all products are created from the one source file. Changes to the source file after validation can result in products being produced from different source files, which may impact on data and product integrity. It is vitally important that validation is an ongoing and parallel process to all other processes. This allows for the early detection of problems and subsequent implementation of fixes to either processing systems or procedures. It is also important that a validation process is included in any processing tests prior to the census. The final validated data released from the processing center should be complete, with details of any changes in the data that may be problematic for users.

⁹⁶ Handbook on the management of population and housing census, Part V Data processing, Chapter F Quality assurance for data processing, section 7 Validation;

Tabulation

19.63 The tabulation is a very important part of the census. The tables and maps are the most visible outcomes of the whole census operation and the most used output (see Chapter 6). As pointed out in the previous sections (see Chapter 6 and Chapter 17) all preparations (dummy tables, computer programmes, etc.) must be completed and tested during the pre-tests and pilot census. The main problems with final tables are those mistakes committed in earlier phases of the census operations, but which may not become visible until tabulation. The need for correction of data and of processing programmes and re-tabulation at this stage can delay considerably the dissemination of the results.

At the end of the validation process, it is a good practice to have a certification committee reviewing and officially certifying the results. Each variable of the Census should be reviewed and certified by geographic area. The information presented to the certification committee (comprising of Census managers and subject matter experts in agriculture) to support the review should be in:

- Anticipation for the Census results (forecast, other surveys, consultations with industry experts)
- Alignment of the results with the current socio-economic context
- Results : comparison with historical data, with admin data, with survey data and with other correlated variables
- Impact of the processing and validation on the raw data
- Impact of holders that left the industry, newcomers and large players
- Recommendation to the Committee to 1) publish as is, 2) publish with a cautionary note, 3) defer publication, 4) not publish.

Box xx. Certification as data validation (case of Canada)

Calculation of sampling error and additional data analysis.

19.64 When sampling is used, for example for the supplementary modules in the modular approach or the rotation modules in the Integrated census/survey modality, the data collected by using sample enumeration cannot be properly used and evaluated unless an indication of the sampling error is associated with the values obtained. In some cases, flags are introduced, warning the user about the range of the sampling error, thus the quality of the data published.

Suggested reading

Handbook on the Management of Population and Housing censuses, rev. 2 (UN, 2016)

An introduction to the data editing process, Dania Ferguson, USDA, NASS;

<http://www.unece.org/fileadmin/DAM/stats/publications/editing/SDE1chA.pdf>

Roberto Benedetti, Marco Bee, etc 2010 Agricultural Survey Methods, Chapters 14 and 15

FAO (1987). Micro-computer-based data processing: 1990 World Census of Agriculture.

UN (1982). Survey data processing: A review of issues and procedures. NHSCP technical study

CHAPTER 20 DATA ARCHIVING

Introduction

20.1 This section on Census Data Archiving is a new important addition to the census programme. The agricultural census is a major statistical operation and significant investments are made when collecting data. Like other data, census data can hold cultural and institutional value far into the future.

20.2 However, past experience has shown that in many countries, particularly in developing countries, for technical and organizational reasons, after few years census data files are no longer available or accessible. In some cases, even aggregated tables may only be available in paper format. This is a major issue for the wider use or reuse of census data, time series and other types of historical analysis and for the overall justification of the high cost of the census.

20.3 The new technological environment provides conditions for addressing this issue for the coming round of censuses with appropriate technical tools. But this aspect should be fully mainstreamed in the census planning and budgeting process so that adequate actions are taken in time. Census data producers should invest resources, including staff, procedures (e.g., format migration), technological infrastructure, and funding, to preserve and archive their digital data. Dedicated specialized staff should be part of the census core team to take care of this aspect from the beginning of census planning.

20.4 Unlike physical materials, digital data must be actively maintained over time to ensure reuse. This includes guarding against hardware and software [obsolescence](#), such as outmoded floppy disks and unreadable file formats, as well as physical threats, such as natural disasters, theft or sabotage. Active maintenance also insures that data are well described; users might be able to open and read the data, but the contents are virtually worthless without adequate description to understand their meaning.

20.5 Fortunately, digital preservation standards make it possible for census offices to manage digital data over the long term. This section summarizes guidance from the International Household Survey Network (IHSN) ⁹⁷ No 003, [Principles and Good Practice for Preserving Data](#) and presents the standards promoted by the leading international organizations at the time of the preparation of the document.

Standards

20.6 This section discusses the standards for description of data and metadata (see Chapter 21). Digital archives have been successfully preserving data for decades. Both the [UK Data Archive](#) and the [Inter-university Consortium for Political and Social Research](#) (ICPSR), for instance, have been archiving data since the 1960s, including agricultural data⁹⁸. Over time, each archiving organization has developed guidance and standards for careful stewardship of data for the long-term. While the “processes of

⁹⁷International Household Survey Network (IHSN) 2009, Working Paper No 003, [Principles and Good Practice for Preserving Data](#) para

⁹⁸ Examples of archiving agricultural data: Haines, Michael, Price Fishback, and Paul Rhode. United States Agriculture Data, 1840 - 2010. ICPSR35206-v2. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2015-08-05. <http://doi.org/10.3886/ICPSR35206.v2>; Scottish Office. Department of Agriculture and Fisheries, University of Edinburgh. Centre for Applications Software and Technology. (1988). Agricultural Census of Scotland, 1987. [data collection]. UK Data Service. SN: 2340, <http://dx.doi.org/10.5255/UKDA-SN-2340-1> .

preserving digital information will vary significantly with the different kinds of objects⁹⁹ being preserved, the central goal must be to preserve information integrity” – i.e., content, fixity, reference, provenance, and context.

Table 20.1. Good Practices for Integrity Features of Digital Content

Integrity Feature	Related Good Practice
Content: ensures that essential elements of digital content are preserved	An agricultural census office is expected to explicitly identify and actively manage data to be preserved.
Fixity: requires that changes to content are recorded, ideally from the moment of creation onward	At minimum, this feature might be addressed through routine use of a <u>checksum</u> to detect intentional or unintentional changes to data and notify data managers for action ¹⁰⁰ .
Reference: ensures content is uniquely and specifically identifiable in relation to other content across time	For example, an agricultural census office is required to adopt and maintain a <u>persistent identifier approach</u> . (a system for assigning and managing enduring identifiers that allows digital materials to be consistently and uniquely referred to over time.)
Provenance: requires digital content to be traceable to its origin (point of creation) or, at minimum, from deposit in a trusted digital repository	This feature requires that an agricultural census office records information (captured as metadata) on the creation and action that have affected the content since its creation (e.g., data deposited in an archive, migrated from one file format to another)
Context: documents and manages relationships or digital content	An agricultural census office that preserves data should document relationships between its own digital content and, to the extent possible, to data managed by other organisations.

OAIS Reference Model

20.7 More recently, specific community¹⁰¹ digital preservation standards have emerged. One major standard is the [Open Archival Information System](#) (OAIS) Reference Model, which was published as an ISO International Standard in 2003. As specified in OAIS [introductory guide](#), the OAIS Reference Model supplies “a general mapping of the landscape that stewards of our digital heritage must navigate in order to secure the long-term availability of digital materials.”

⁹⁹ For this paper “object” means data record

¹⁰⁰ A checksum is simply a hash or calculated sum that can be used to verify integrity of data that is stored or preserved. A checksum lets users know if a file has been changed or corrupted. There are different types of hashes that can be computed (e.g., md5, sha256) -- each with a certain level of detail. Many file storage systems have built in fixity checks. Further be found on <https://blogs.loc.gov/digitalpreservation/files/2014/02/NDSA-Checking-your-digital-content-Draft-2-5-14.pdf?loclr=blogsig>

¹⁰¹ In this section “community” is used in the meaning of “digital preservation community”

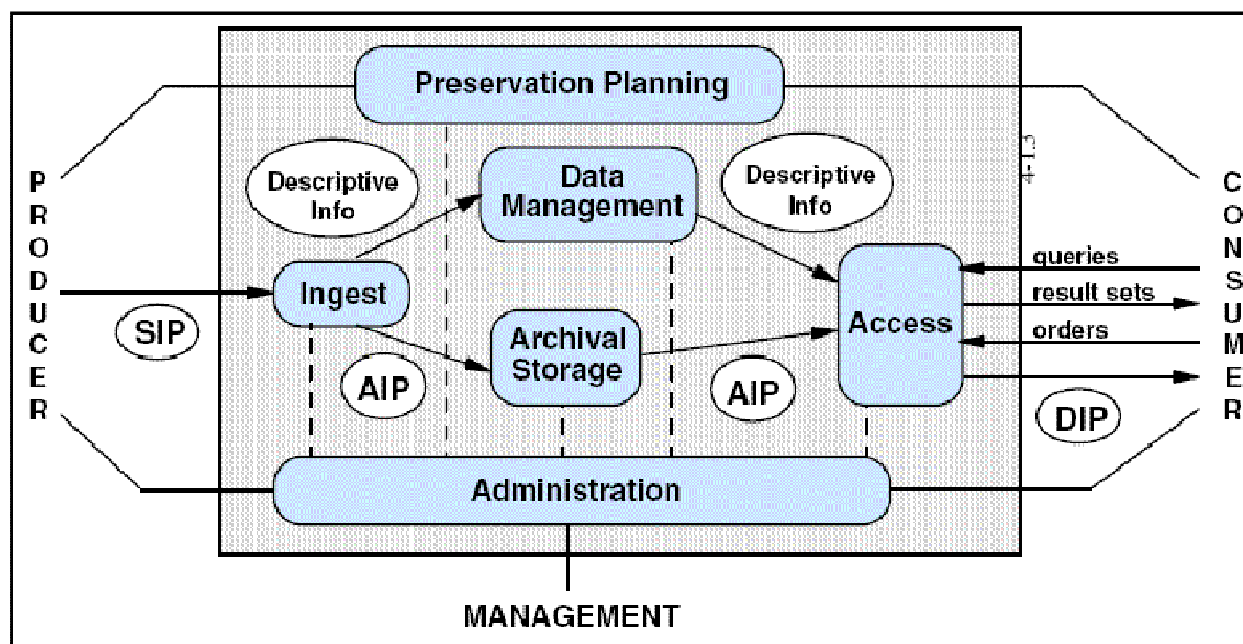


Figure 20.1 The High-level OAIS Reference model

20.8 In a nutshell, the OAIS Reference Model defines the roles and functions of and information necessary for managing digital material over the long term and making it accessible to interested users.

20.9 The roles include:

- ◆ Producer -- creates the digital content and then formally transfers its custody to an archive
- ◆ Management -- oversees the funding and planning of the digital archive (the day-to-day operations are managed in the functions described below)
- ◆ Consumer -- uses the digital content, and should be able to understand and interpret the information.

20.10 The functions include:

- ◆ Ingest -- accepts and takes custody of digital materials from producers ('Submission Information Packages' or SIPs), performs quality assurance checks, and generates final versions ('Archival Information Packages' or AIPs) that can be stored for both preservation and access.
- ◆ Archival Storage -- stores, maintains, and retrieves the AIPs. Storage includes error checking and media refresh.
- ◆ Data Management -- manages descriptive information that documents holdings, as well as the administrative data used to manage the repository.
- ◆ Administration -- operates and coordinates the OAIS functions.
- ◆ Preservation Planning -- monitors and plans so the digital content stored in the repository remains accessible and understandable over the long term.
- ◆ Access -- enables consumers to request and access the contents ('Dissemination Information Packages' or DIPs) (see also section ... on access to micro-data).

20.11 Integral throughout the OAIS process is metadata about the digital material to be preserved. Metadata are fundamental to achieving the "[FAIR Data Principles](#):" Findable, Accessible, Interoperable, and Re-usable. A well-prepared data set "contains information intended to be [complete and self-explanatory](#)" for future users. That is, those responsible for preserving the digital information must

“ensure that the preserved information is [independently understandable](#) to the users, in the sense that the information can be understood by users without the assistance of the information producer.”

20.12 For agricultural census data, common descriptive and structural metadata standards include the [Data Documentation Initiative](#) (DDI) standard. DDI provides for mark-up of rich variable-level information and addresses the entire lifecycle of data management. Many national statistical offices use the Statistical Data and Metadata eXchange standard (SDMX), to document aggregate time series data. [Dublin Core](#) is another more basic metadata standard that allows for generic description.

20.13 Preservation metadata - supported in DDI - documents preservation-related actions, including:

- ◆ Reference Information -- unique, unambiguous identifiers
- ◆ Context Information -- documents the relationship with other objects
- ◆ Provenance Information -- provides an audit trail of any changes to the object
- ◆ Fixity Information -- provides data integrity checks to insure the object has not been unintentionally altered
- ◆ Access Rights Information -- identifies any access restrictions

IHSN developed a Microdata Cataloging Tool (NADA) to support countries wishing to use the DDI format for preservation of metadata (<http://www.ihsn.org/home/software/nada>). More than 60 national statistics offices use this tool for micro data archiving (examples: the Philippines - <http://psa.gov.ph/psada/index.php/catalog>; Ethiopia - <http://www.csa.gov.et/index.php/component/content/article/11-enada/18-data-archive>).

Trusted Digital Repository (TDR)

20.14 While the OAIS Reference Model provides high-level guidance on functional and informational models to support long-term maintenance and access, it does not go into detail about the organizational aspects of operating an open archival information system. The 2002 report (RLG – OCLC Report, RLG, Mountain View, CA May 2002) [Attributes of a Trusted Digital Repository: Roles and Responsibilities](#) fills that gap by defining “the [characteristics of reliable archiving services](#) for heterogeneous research collections.” These characteristics include:

- ◆ OAIS Compliance – a repository must commit to designing and implementing storage, access, and information systems that align with the OAIS Reference Model.
- ◆ Administrative Responsibility -- proven commitment to implementing community standards that directly influence its viability and sustainability
- ◆ Organizational Viability -- transparent business practices and staffing committed to long-term stewardship of digital materials
- ◆ Financial Sustainability -- proven and sustainable business plan over time
- ◆ Technological and Procedural Suitability -- ensure appropriate hardware and software are implemented, with regular external audits. Three dominant preservation implementations include:
 - [Normalisation](#) – converting one format into a simpler or more stable preservation format (e.g., SPSS files to ASCII formats)
 - [Migration](#) – converting an older version of a format to a newer or more stable format (e.g., SPSS version 3 to most current SPSS version)
 - [Emulation](#) – replicating the original environment in which digital material was created.

- ◆ System Security -- all systems are designed to assure security, with detected changes or losses documented
- ◆ Procedural Accountability – repository practices are documented, monitored, and made available upon request

20.15 The TDR document “has become a de facto community standard for good practice by data producers that manage digital content over time.”

Evaluation and Audit

20.16 For those census offices that want to demonstrate compliance with the community standards described above, a good start is to conduct a preservation self-evaluation. The Digital Preservation Management: Implementing Short-term Strategies for Long-term Problems workshop series, for example, created a checklist (Annex E. Survey of Institutional Readiness, International Household Survey Network (IHSN) 2009, Working Paper No 003, Principles and Good Practice for Preserving Data) to help census offices “consider their digital assets in terms of scope, priorities, resources, and overall readiness to address digital preservation concerns.”

20.17 Next, census offices can create their own preservation policy. This helps solidify goals and prioritizes actions. According to [Principles and Good Practice for Preserving Data](#), a “good policy reflects the mandate of the organization to preserve data” and should:

“address the attributes of a Trusted Digital Repository; present a high-level overview of an organisation’s digital preservation programme; reflect current not future capabilities of the digital preservation programme; provide links to more detailed and frequently-updated documents; e.g. lower-level policies and procedures; point to the organisation’s plan for priorities, time-frames and future development; and document the policy-approval and maintenance process.”

20.18 In addition to formulating a preservation policy of the census office, formal evaluations are available and recommended. These include:

- ◆ [Data Seal of Approval](#) -- a concise set of guidelines against which census offices self-assess, which is then peer-reviewed.
- ◆ [TDR Checklist](#) -- a rigorous ISO standard (16363) .
- ◆ Digital Repository Audit Method Based on Risk Assessment ([DRAMBORA](#)) -- an alternative evaluation that assesses capabilities, identifies weaknesses, and recognizes strengths

20.19 “[Ten principles for digital preservation repositories](#)” summarizes the core criteria for trustworthy repositories:

- ◆ The repository commits to continuing maintenance of digital material for identified community/communities.
- ◆ Demonstrates organizational fitness (including financial, staffing, and processes) to fulfill its commitment.
- ◆ Acquires and maintains requisite contractual and legal rights and fulfills responsibilities.
- ◆ Has an effective and efficient policy framework.

- ◆ Acquires and ingests digital materials based upon stated criteria that correspond to its commitments and capabilities.
- ◆ Maintains/ensures the integrity, authenticity and usability of digital materials it holds over time.
- ◆ Creates and maintains requisite metadata about actions taken on digital materials during preservation as well as about the relevant production, access support, and usage process contexts before preservation.
- ◆ Fulfills requisite dissemination requirements.
- ◆ Has a strategic program for preservation planning and action.
- ◆ Has technical infrastructure adequate to continuing maintenance and security of its digital material.

◆

20.20 In practical terms, as already mentioned, the data archiving should be included in the census planning. The preparation starts with a preservation self-evaluation (see **paragraph xx**). Depending on the results and the requirements of the desired archiving system, appropriate financial, IT and human resources should be planned. A detailed time schedule of archiving activities, synchronized with the overall agricultural census time schedule needs to be developed, and regularly monitored and updated.

20.21 In conclusion, it should be noted that standards exist to help census offices preserve digital material so they are accessible and independently understandable over the long-term. Formal evaluations can help assess an organization's trustworthiness as a digital steward. Ensuring good preservation practice is a continual process rather than a destination.

20.22 It is also important to take adequate measures to physically secure data. It is impossible to know when data are going to be destroyed unintentionally; by natural disasters, fires, power failures, programming errors which can all contribute to the loss of important data files. For this reason, it is always stressed that there should be backup copies of data. These copies could be both "on-line" and "off-line", but remember to take proper precautions to prevent the destruction of all copies at the same time, because they are stored on the same micro-computer, server and/or in the same room or building. For example, one copy of the data could be stored in a fire-proof safe or a copy of sub-national data could be maintained in each of the sub-national offices.

CHAPTER 21 SAFE ACCESS TO MICRODATA

21.1 Chapter 20 provided guidance on how to properly archive and maintain census data, mainly in electronic data files. Another important consideration is allowing wider and easy access to census data, particularly the microdata. While aggregated tables may be easily accessible in paper or electronic publications, access to micro data may be needed for some more in-depth analysis. This wider use of micro data can increase the relevance and value of the census and benefit a larger audience of users. However, access to census micro data requires adequate legal and technical measures to preserve confidentiality of respondents, integrity of the master database and prevent any misuse of the census data.

21.2 This section discusses issues related to safe access to census micro data and provide guidance on possible framework and tools that can be considered.

What is microdata?

21.3 Microdata refer to the information that is recorded by or from the respondent when a survey or census is conducted. For the agricultural census this would correspond to the data collected for the holding. Each row in the microdata corresponds to a holding and each column to the data variables. In addition to the variable labels, researchers and other data users need metadata which helps them understand the codes, definitions and concepts underpinning the data that were collected.¹⁰²

21.4 Several publications¹⁰³ provide detailed guidance on accessing to microdata and an overview and summary of the main considerations are given in this section.

Use of microdata

21.5 Microdata allows researcher to use the census or survey data to analyze questions which require a finer grained analysis than the original tabulations. For example, the published tables often show results only for each variable separately, but more in depth analysis may require an understanding of the inter-relation between variables, and the relation between a set of variables to explain the outcome on another variable. It is not possible for the statistical agency to publish all relevant cross-tabulations in the main report. Access to microdata therefore allows researchers to explore meaningful questions through the data available. For further links on rationale for microdata see Eurostat, 2009 and Eurostat, 2005¹⁰⁴

¹⁰² Organization for Economic Cooperation and Development, Glossary of Statistical Terms, Accessed from <http://stats.oecd.org/glossary/detail.asp?ID=1656> on 1/1/2014

¹⁰³ Further links:

Global Strategy (2014) Providing Access to Agriculture Microdata <http://www.gsars.org/providing-access-to-agriculture-microdata-a-guide/>

Inter-university Consortium for Political and Social Research (ICPSR). 2009. "Principles and Good Practice for Preserving Data", International Household Survey Network, IHSN Working Paper No 003, December 2009. Available

<http://www.ihsn.org/home/sites/default/files/resources/IHSN-WP003.pdf>

Dupriez, Olivier and Ernie Boyko. 2010. "Dissemination of Microdata Files. Formulating Policies and Procedures", International Household Survey Network, IHSN Working Paper No 005., <http://www.ihsn.org/home/sites/default/files/resources/IHSN-WP005.pdf>

¹⁰⁴ Eurostat. 2009. "Work Session on Statistical Data Confidentiality. Manchester 17-19 December 2007", in Methodologies and Working Papers. http://www.unece.org/stats/publications/Proceedings_statistical_data_confidentiality.pdf

Agriculture Microdata

21.6 The particular characteristic of agriculture data is that holdings because they are units of production fall within the definition of being enterprises or businesses. Disclosure control risks and techniques for business data differ from those for household surveys. For example, *“business data are never released by agencies unless highly perturbed by, for example, removal of all large businesses and application of other disclosure limitation techniques or by replacement of the entire dataset with a synthetic dataset. This is because of the typical skewed distributions and the likelihood that values of sensitive variables are released through publically available sources.”*¹⁰⁵ In addition, enterprise or business data of large commercial farms are also often small-target populations and therefore more difficult to anonymize.¹⁰⁶

21.7 However, the characteristics of agriculture census and survey data can be said to share characteristics with both household survey data and enterprise survey data. This is because agricultural holdings consist of both small farms managed by individuals often for subsistence, and commercial farms or enterprises, often large scale and managed by legal entities, which are more similar in characteristics to entities in typical enterprise surveys. Not only the entities themselves but also the variables in the data set need to be considered as agricultural data may contain sensitive information on gross margins, sales etc., or variables which can reveal this, such as production/harvest, receipts and costs.

21.8 As discussed below, certain types of access methods may be more suited to farm units in the commercial sector, where greater limits may need to be placed on the range of users who can access such files or on how users interact with the files. Where farm units are relatively homogenous and the universe contains a large number of them then other methods can be applied.¹⁰⁷ The characteristics and therefore the appropriate methods of access for each data file would need to be considered individually by disclosure control experts in the statistical agency.

21.9 Also particular to agricultural data is the issue of identity disclosure through release of small scale geographic identifiers from geo-referenced data on holdings or parcels or from area frame sampling, which is discussed in Chapters 12 and 13.

Confidentiality

21.10 Statistical agencies should follow the United Nations Principles of Official Statistics in that individual data collected by statistical agencies for statistical compilation, whether they refer to natural or legal persons, are to be strictly confidential and used exclusively for statistical purposes. In addition, producers of official statistics do not disclose, either directly or indirectly, characteristics about protected units to any third party in such a way that any user might identify an individual unit or derive additional information (information not known to the user before) about a protected unit.

Monographs of official statistics - Work session on statistical data confidentiality - Geneva, 9-11 November 2005

<http://ec.europa.eu/eurostat/ramon/statmanuals/files/KS-73-05-623-EN.pdf>

¹⁰⁵ O’Keefe, C. and Shlomo, N. (2012) Comparison of Remote Analysis with Statistical Disclosure Control for Protecting the Confidentiality of Business Data, *Transactions on Data Privacy* 5 pp403-432.

¹⁰⁶ from Dupriez, Olivier and Ernie Boyko. 2010. “Dissemination of Microdata Files. Formulating Policies

¹⁰⁷ Global Strategy (2014) Providing Access to Agricultural Microdata, p 34

21.11 Meeting researchers' needs while ensuring the greatest protection for maintaining the privacy of the respondents are prime considerations when choosing a microdata access system. Providing access to microdata requires that the statistical agencies balance the demands emanating from the research community with their legislated requirements to maintain the confidentiality of the information that they have collected from respondents. If the statistical agency were to fail to do this, they would run the risk of undermining their credibility and the confidence of the respondents and thus losing their support.

Legal and policy frameworks

21.12 When providing access to microdata the agency must comply with the legal framework and charters under which it operates. It is essential to maintain respondent support in order for the agency to succeed in its data collection activities. At the same time it is recognized that there are methods for ensuring confidentiality and making microdata available for statistical purposes. It is important to have clear policies on the actions that can be taken by the agency regarding census microdata access and that this information is available to the public in a transparent mode.

21.13 Laws governing statistics vary among countries and in some cases it may be necessary to amend the legislation before census microdata can be disseminated. It is up to each individual National Statistical Office (NSO) to interpret the legislation and provide services accordingly. In some cases it may be necessary to amend the legislation under which the organization works before census microdata can be disseminated in some manner. In some cases, the release of microdata may be prohibited (although this is less and less common as statistical legislation is revised) while in other instances microdata can be released under certain circumstances. The manner in which this is interpreted is generally left to the professionals and experts in the NSOs.

21.14 Once the legal framework has been verified the next step is to ensure that the agency has explicit policy for dissemination of microdata. The first precaution to ensure confidentiality is to apply statistical disclosure control to the file. The policy provides extra precaution in terms of safeguarding confidentiality when providing access to microdata files to researchers. It sets out the conditions under which the files can be used, the agreement between the user and statistical agency in terms of use of the file, the responsibilities of both parties and the sanctions to be applied if the agreement is not honored. For more details see <http://www.gsars.org/providing-access-to-agriculture-microdata-a-guide/>

Metadata and Statistical Disclosure

21.15 Before statistical data can be made available to users appropriate metadata needs to be documented to allow users to understand the data contained in the file and therefore how to analyze it. *"Metadata are usually defined as 'data about data'. It is important to provide users with a proper data dictionary describing the content of all variables included in a dataset. But good metadata contains much more than a data dictionary"* (IHSN working paper No. 005.¹⁰⁸). Refer also to WCA 2020 Vol 1 para...

¹⁰⁸ Dupriez, Olivier and Ernie Boyko. 2010. "Dissemination of Microdata Files. Formulating Policies and Procedures", International Household Survey Network, IHSN Working Paper No 005, See section 2 of the report.

21.16 Safeguarding confidentiality means that best attempts must be made to ensure that the file is not disclosive. A **disclosure** occurs when someone who is using a microdata file recognizes or learns something they did not previously know about a respondent in the census or survey or when there is a possibility that a holding or individual in the holder's household be re-identified by an intruder using information contained in the file.

21.17 There are two main ways in which disclosure can occur, either by identity disclosure or attribute disclosure. **Identify disclosure** occurs when a direct identifier left in the file, (e.g., a name, telephone number or address) from which the identity of the respondent can be learned. **Attribute disclosure** occurs if an attribute or combination of attributes (e.g., a large commercial farm or type of rare crop) can be directly associated with a particular respondent. Persons with knowledge of the region would be likely to identify that person based on the known attributes.

21.18 Residual disclosure is yet another form of risk that must be guarded against. This occurs when successive retrievals from a file can be compared (subtracted) in order to isolate a respondent's value. For example, if the first retrieval contains a grouping that is 1-100 and a subsequent retrieval by the same user is for the group 1-99 and the 2 retrievals are compared, the single value can be identified by subtraction. This can also occur when one data retrieval is compared to a previously published table.

Statistical Disclosure Control

21.19 Statistical Disclosure refers to the process of ensuring that the confidentiality requirements that govern the work of the NSO are met and that the risk of revealing information about the respondent is minimal. This is also referred to as anonymization. It is usually recognized that there is no such thing as completely 'safe' data. Thus, it is a matter of weighing the risk of disclosure against the benefits of access. Disclosure control risk is affected by many factors, including:

- ◆ The sensitivity of the data
- ◆ The existence of outside sources of information that can be used to attempt re-identification of respondents by matching to combinations of variables that might re-identify a respondent.
- ◆ Ability to combine the released data with data from other publically available sources
- ◆ Whether the microdata file is from a sample survey or a complete enumeration census,

21.20 Disclosure control requires assessment of the risk of disclosure and based on this selection of appropriate disclosure control techniques. The statistical disclosure control procedures generally involve:

- ◆ Removal of direct identifiers such as – names, addresses, telephone numbers, detailed location of agricultural holdings,
- ◆ Removal of indirect identifiers such as detailed location of agricultural units. This includes geographic coordinates, location of sample segments , plot locations or segment locations whether recorded as attribute information or as part of an area frame sample
- ◆ Application of anonymization techniques based on the disclosure risk identified. Detailed technical details of techniques and software to assist in anonymization are not discussed here but are widely available in the literature.
- ◆ Evaluation of the file for utility and information loss

21.21 Particular risks are associated with population and sample 'uniques' and rare occurrences, for example large commercial farms or farms with legal status as juridical person in countries where the

majority of farms are managed by individuals. Other rare occurrences such as presence of rare crops or animals which might allow identification by linkage to other data sets. This is particularly pertinent to small island states where outliers in the data set can often be population 'uniques' and thus easy to identify.

21.22 Agencies also need to carefully consider whether to release sensitive variables which might reveal outliers, such as company profit and gross margins or variables such as production which can reveal this. More on technical methods for disclosure control can be found in dedicated publications and webpages¹⁰⁹

Types of access

21.23 Varying methods of access exist, with varying trade-offs between access, availability of information, costs and confidentiality.

Public Use Files (PUFs)

21.24 PUFs (which may be from a survey or a sample of census records, full censuses are rarely released) undergo a rigorous statistical disclosure control (SDC) process so that the chance of re-identification of respondents is minimal. Researchers are required to agree to certain conditions of use in a 'click through' agreement.

21.25 PUFs will have a minimal amount of geographic detail below the national or larger subnational areas. As well, all direct and indirect identifiers will have been removed. Certain records and variables may be suppressed, regrouped and recoded, particularly sensitive information.

21.26 This is only feasible if the holding units are relatively homogeneous and there are a large number of them in the universe. Since agriculture populations often consist of a commercial (or estate) sector and a household sector, this method can usually only be applied to the household sector. The commercial sector would have to be analyzed separately from the microdata as these units cannot be anonymized safely without destroying the usefulness of the file. In certain cases it may be possible to obtain the permission of the respondents to share their data for specific studies. There may be some risk of disclosure in virtually all public use files.

¹⁰⁹ CENEX-SDC. 2007. "Handbook on Statistical Disclosure Control" <http://neon.vb.cbs.nl/casc/handbook.htm>

Eurostat Manual on Disclosure Control Methods

http://ec.europa.eu/eurostat/ramon/statmanuals/files/manual_on_disclosure_control_methods_1996.pdf

United Nations, *Managing Statistical Confidentiality & Microdata Access*, 2007, accessible at

http://www.unece.org/fileadmin/DAM/stats/publications/Managing_statistical_confidentiality_and_microdata_access.pdf

United Nations Statistical Commission, "Principles and Guidelines for

Managing Statistical Confidentiality and Microdata Access," Thirty-eighth session Available in English only 27 February - 2

March 2007, accessible at <http://unstats.un.org/unsd/statcom/doc07/BG-Microdata-E.pdf>

[Links to software for disclosure control](#)

Tau Argus of Statistics Netherlands is one of the most widely used stand alone disclosure control software

<http://neon.vb.cbs.nl/casc/..%5Ccasc%5Ctau.htm>

SDCMicro for R Software

<https://cran.r-project.org/web/packages/sdcMicro/index.html> and

M. Templ, B. Meindl and A. Kowarik. Introduction to Statistical Disclosure Control, Paper prepared for The International Household Survey Network, Vienna, 2014. <http://www.ihsn.org/home/software/disclosure-control-toolbox>

- ◆ **Advantages:** These files can be broadly distributed to a wide range of users who can access the data on their own premises with a minimal risk of disclosure. They are widely used to teach data analysis skills and to provide the basis for initial analyses of a topic. Researchers may use a PUF before attempting other avenues of access for more detailed work.
- ◆ **Disadvantages:** These files will lack geographic detail and will be missing some variables that are judged to be sensitive or too revealing about the respondents. They generally take the data producer more time to produce than is the case for tables (although statistical disclosure control must be performed on tabular data as well). Statistical and subject matter specialists must work together to create a file that is considered safe enough to release.

Licensed Files

21.27 Licensed files are also anonymized but with the possibility of fewer statistical disclosure control procedures being applied, depending on the nature of the file and the policies of the producer. The data producers ask the researchers to identify themselves and provide explicit details on their research. They will be asked to sign a license which will identify who can have access to the file and what the conditions of use are and impose penalties for breaching this. The researcher's organizations may also impose certain requirements. *"Licensing agreements permit a researcher to use confidential data offsite, but under highly restricted conditions as spelled out in a legally binding agreement. Arrangements that place restrictions on who has access, at what locations, and for what purposes access is allowed, normally require written agreements between agency and users. These agreements usually subject the user to fines, being denied access in the future and/or other penalties for improper disclosure of individual information and other violations of the agreed conditions of use. Users may be subject to external audits conducted by the agency to assure terms of the agreement are being followed. Users in violation may be required to pay fines or be subject to other legal penalties."*¹¹⁰

- ◆ **Advantages:** Since the researcher has agreed to conditions that restrict what can be done with the files, licensed files **may** contain more detailed information than PUFs. Unless there are specific laws within the country, the only sanction that can be applied to those who breach the license conditions is to remove access privileges from the users and their organizations. Data producers generally feel that there is less risk associated with a licensed file than a PUF as there is more interaction with the user and a chance to ensure that the importance of the conditions is understood. Requiring the researcher's organization to sign an undertaking offers more security for the data producers as most organizations do not want to risk sanctions.
- ◆ **Disadvantages:** The cons of licensed files are similar to those for PUFs. From a users' perspective, it takes longer to obtain access because of the licensing process. These files will still lack geographic detail and will be missing some variables that are judged to be sensitive or too revealing about the respondents. As with PUFs, these files generally require more time to produce than is the case for tables. The skills required to produce the files are similar to the ones for PUFs. In addition, there will be a requirement for someone to manage the licensing process.

Remote Access Facilities (RAFs)

¹¹⁰ US Federal Committee on Statistical Methodology. 2005. "Statistical Policy Working Paper 22 (Revised 2005) – Report on Statistical Disclosure Limitation Methodology". Accessed from http://www.fcsm.gov/working-papers/SPWP22_rev.pdf on 06/01/2014

21.28 RAFs involve a service window provided by the data producers which allow researchers to supply the algorithm they will be using in their analysis. The researcher is provided with a synthetic file that replicates the structure and the content of the actual data sets. The researcher can then develop programs and procedures using tools such as SAS, SPSS, STATA or R. The programs can be transmitted to the data producer's staff that can run the job against the actual data set and vet the results for disclosure before returning the output to the user.

21.29 There are two types of RAFs. The first involves remote execution where the researcher submits a program and receives the vetted output over the Internet. The second type involves the submission of data requests into an interactive system which can produce tabulations and vet the data 'on the fly'. These data requests only require staff intervention if the access software detects disclosure issues.

- ◆ **Advantage:** Both types of RAFs are effective at ensuring that the confidentiality requirements of the data producer are met. The use of synthetic files informs the researcher of the full structure and content of the data set.
- ◆ **Disadvantages:** This type of service requires that the data producers' staff be available to submit the jobs and vet the results. This is an expensive process for which the costs will likely have to be recovered and the users may find it slow. Interactive services require resources to develop the systems. These systems require less staff time. Many instances of the application of RAFs are only capable of producing tabulations while others may only permit analytic outputs. It should be possible for users to specify models using synthetic files to be run against the detailed files. However, running models on the data set often requires much iteration which would be impossible to do in an RAF environment as this could lead to residual disclosure. It should be noted that there is a risk of residual disclosure when the comparison of successive retrievals may isolate individual respondents.

Data enclaves

21.30 A data enclave consists of a facility within the premises of the statistical organization to which researchers can come in order to perform their research on detailed files. These files are the most detailed files available to the researchers other than the master file itself. A data enclave will be equipped with computers that are not linked to the Internet or to an external network. Information cannot be downloaded using USB ports or be written to a CD – DVD drive. Users will be expected to identify the part of the data set that they're interested in and only that subset of data will be made available to them. The results produced by the researcher must be vetted by a statistical organization staff member before they can be removed from the premises. Researchers must have specific goals prior to being allowed to perform the research in the data enclave. It is common for the statistical organization to require the researcher to identify their objectives and to demonstrate a legitimate need to ask for access to these data. They would also require that the proposed research be consistent with the objectives of the organization.

- ◆ **Advantages:** A major advantage of a data enclave is the amount of detail that can be provided to the researcher. In comparison to RAFs, data enclaves make it possible for the researcher to conduct complex analysis.
- ◆ **Disadvantages:** The major disadvantages of a data enclave are that they are the most expensive for the statistical organization to operate as appropriate space must be made available and staff

time to vet the outputs and are inconvenient for the researchers as they require that researchers travel to a central location which may be in a different city.

- ◆ They are generally operated under a cost recovery basis unless the SO receives a grant to operate them.

Deemed Employee

21.31 A final model for consideration is the possibility that the researcher may be sworn in to work with the agency as a temporary staff member. In this case the researcher would be subject to the same secrecy and ethical provisions and as the regular staff. This can also take the form of research fellowships and post-doctoral programs. This is generally limited to projects which assist the data producer in meeting their organization's goals and for which they do not possess the necessary skills.

- ◆ **Advantages:** this model has the advantage of providing the researcher with access to the full detail of the master file. The data producer's staff will be available to answer questions about the data. This model protects the confidentiality of the data and also furthers the goals of the organization. Confidentiality is maintained, access to the full data set is possible; but researchers must be available to work at the NSO premises in HQ or regional office if they exist.
- ◆ **Disadvantages:** As with the data enclave, this model requires that the researcher travel to the location of the statistical producer. Since the researcher will be working on a project of interest to the producer there is less choice in research topic for the researcher.

Further details of methods of access can be found at:

<http://www.icpsr.umich.edu/icpsrweb/content/deposit/guide/chapter5.html>

Some examples of Anonymized Surveys with Agriculture Data are presented in Boxes 21.1 and 21.2.

Box 21.1 Nigeria: General Household Survey-Panel 2010-2011 (Post-Planting)

The GHS - Panel survey is a subsample of the annual GHS cross section survey conducted by NBS. GHS - Panel survey is the first wave of a long-term project to collect panel data on households, their characteristics, welfare and their agricultural activities. The GHS -Panel will be conducted every two years.

This first wave consists of two visits to the household: the post-planting visit (August - October 2010) occurred directly after the planting season to collect detailed information on household characteristics including preparation of plots, inputs used, labour used for planting and other issues related to the planting season. The post-harvest visit (February-April 2011) occurred after the harvest season and collected additional information on household characteristics along with information on crops harvested, labour used for cultivating and harvest activities, and other issues related to the harvest cycle.

The team consisted of staff with from the subject matter and data processing area with systems and computing expertise. This team is familiar with the surveys as they also do the survey documentation for all the NBS surveys.

Tools and procedure: After a clean file was produced, the team removed all the direct identifiers (similar to the Rwandan approach below) and then used the SDCMicro tool from the IHSN to identify the risks carry out the suppression.

Publication: The Catalogue record for this survey can be found at:
<http://nigerianstat.gov.ng/nada/index.php/catalog/31/overview>

This catalogue is based on the NADA software developed (freely distributed by the IHSN) and housed on the Nigerian Bureau of Statistics web site. The survey can be downloaded as public use file by going to the 'get data' tab on the catalogue record and completing a registration form.

Box 21.2 Rwanda - Comprehensive Food Security and Vulnerability Analysis and Nutrition Survey 2012 (CFSVA)

The CFSVA process generates a document that describes the food security status of various segments of a population over various parts of a country or region, analyses the underlying causes of vulnerability, and recommends appropriate interventions to deal with the problems. CFSVAs are undertaken in all crisis-prone food-insecure countries. The shelf life of CFSVAs is determined by the indicators being collected and reported. In most situations, CFSVA findings are valid for three to five years, unless there are drastic food security changes in the meantime.

Anonymisation:

The team from the National Institute of Statistics of Rwanda was composed of statisticians who worked on the survey, staff in charge of surveys/censuses documentation, data processing staff with IT skills, an advisor from ADP/PARIS21 to assist and provide technical assistance in the first round of surveys/censuses documentation and creation of microdata files. This work normally takes between 3-6 months.

Tools: Normally the data entry and data processing is done in CPro, and then converted into SPSS and STATA for analysis. The microdata files are created using mostly SPSS, and STATA occasionally based on the demand of data users.

Procedures:

For creating Public Use files: removed (1) names of respondents, (2) remove all addresses from the village level (lowest administrative entity) up to the District level (since the survey estimates are representative up to the district level) to avoid any person who can try to come up with estimates at the lower level than the district, which will not be reliable due to sample size. (3) collapse all geographic information (similar to no 2). Disclosure techniques applied were micro-aggregations, top coding, bottom coding.

For creating Licensed and enclave Files: The same procedures are used as for public use files. Disclosure techniques applied were micro-aggregations, top coding, bottom coding

Review / approval process: The data release committee reviewed the created microdata files before they online for release. This committee checks if the files were created properly. This committee advises the Director General to approve the created files and authorize them to be released; this power is delegated to the Director of Statistical Methods, Research and Publication.

Publication: The catalogue record for this survey can be found at

<http://catalog.ihsn.org/index.php/catalog/4149>

This catalogue is based on the NADA software developed and is housed on the IHSN web site.

The survey can be downloaded as public use by going to the 'get data' tab on the catalogue record and completing a registration form.

CHAPTER 22 POST ENUMERATION SURVEY (PES)

No matter how well a census of agriculture is organized, it is difficult to avoid non-sampling errors, such as coverage and content errors, when data is collected and processed. Non-sampling errors creep into data generally because of mistakes committed at different phases of the census: preparatory activities, data collection, data processing and data tabulation. Therefore, it should be a good practice in agricultural censuses to evaluate the accuracy of data collected so census organizers are aware of its quality and users are aware of data limitations. This chapter discusses the post-enumeration survey (PES), which is a complete and independent re-enumeration of a representative sample of census holdings followed by matching each holding enumerated in the PES with information from the census enumeration.

Introduction

22.1 Section 3.6 discussed the need for an effective quality assurance framework and indicated that ‘the major goal of quality assurance programme for the Census of Agriculture is to prevent and minimize potential errors at design stage and detect errors as soon as possible so that timely remedial actions can be taken even as the census operations continue. The focus should be to prevent errors from reoccurring, to detect errors easily and inform the concerned staff so that corrective actions are taken in time and errors are not repeated’. Therefore, all efforts should be first made to design and implement an effective quality assurance programme to minimize errors in census results. However, despite all the measures taken, some coverage and content errors are unavoidable and it is important to measure, analyze and report on these errors. This is best done via an independent post-census enumeration survey.

22.2 Therefore, it should be a good practice in censuses and surveys to evaluate the accuracy of data collected. The large number of enumerators and supervisors employed, the number of steps involved in organization, difficulties in controlling operations, particularly in remote areas, makes necessary to check the quality of data to be disseminated. Census organizers should be aware of the quality of the data before releasing them for public use; and data users should be aware of data limitations in order to avoid mistakes in decision making.

22.3 The post enumeration survey (PES) is a complete re-enumeration of a representative sample of a census population followed by matching each holding enumerated in the PES with information from the census enumeration (UN, 2008). The results of the comparison are mainly used to measure coverage and content errors (also known as response errors) in the context of the census. The decision whether to measure coverage error, content error or a combination of the two depend upon the evaluation objectives. These, in turn, depend on national census experience in terms of past and anticipated errors, user and public concerns, and the financial and technical resources available for evaluation. The PES should be carried out right after the census enumeration is completed. In the cases of the modular and integrated sample/survey modalities, the PES should be conducted soon after the core module and the light census, respectively. In the case of the use of registers as a source of census data, the PES should be conducted after the field data collection.

22.4 The PES is an independent evaluation of the quality and accuracy of the census. It demands adequate financial, human and other resources. A successful PES calls for a good sample design and survey implementation. Mention should be made that the matching exercise can be somewhat complex (2010 WPHC).

Types of errors

22.5 There are two types of errors in census and survey work:

- ◆ **Sampling errors** occur when sampling is used. They are that part of the difference between population values and sample estimates thereof, derived from a random sample, which is due to the fact that only a sample of values is observed. Sampling errors can be estimated and reduced by enlarging the sample size.
- ◆ **Non-sampling errors** appear in all censuses and surveys. Strictly speaking, they are the result of mistakes committed in various phases of the census and survey work, including data collection. These errors include over- or under-coverage of the frame, errors resulting from poorly worded questionnaires, mistakes at the stage of the processing of the data, etc.

22.6 The accuracy is a function of both types of errors: sampling errors and non-sampling errors. A measure of accuracy is given by the total error also known as the statistical error.

Statistical Error = Sampling error + Non-sampling error + Bias due to estimator

22.7 There are various methods of detecting and controlling data errors at different stages of the census (see Chapter 7), including: (i) data checking as a part of supervision of field enumeration, and (ii) quality checks of census tables against administrative or other available data. The purpose of this section is to discuss the various sources of non-sampling errors in agricultural censuses and to describe the PES as an independent assessment of such errors.

Non-sampling errors

22.8 In each census's phase non-sampling errors can be generated and can be classified with reference to the source of the error. The main non-sampling errors related to field data collection that can be measured by the PES are the following:

- ◆ **Coverage errors:** due to lack of uniqueness in the correspondence between the census frame and the holdings enumerated. This occurs when there is under-coverage or over-coverage (due to duplication or erroneous inclusion). In order to measure the coverage error, it is necessary to carry out a PES and to apply specific estimation probabilistic models.

Coverage errors may be due to incomplete or inaccurate maps or lists of enumeration units, failure on the part of enumerators to canvass all the target agricultural holdings in their assignment areas, etc. These may also occur when there is unit non-response such as a contact failure due to unavailability (absence during the reference period), imperfection in the contact information (incomplete, not updated) or complete refusal to respond.

- ◆ **Content errors** (also known as response errors) are errors that arise in the incorrect reporting or recording of the holding characteristics. They may be caused by poorly phrased questions or instructions, or enumerator errors in phrasing the census questions; inability or misunderstanding on the part of respondents in respect of answering specific items; deliberate misreporting; items non-response, etc. Content errors are common in countries where holders do not keep records of their agricultural operations and do not have clear concepts of area measurement.

PES should also be able to detect their magnitude. It is caused by several factors as: faulty recall by the respondent; lack of knowledge of the subject; incorrect filling of the questionnaire (not understanding the questions or fraudulent response); incorrect transcription of data (by the respondent and/or by the enumerators in general); unclear unit of measure of the detected variable (this is a significant problem in agriculture because the units of measure can be very different also for neighbouring areas and communities).

22.9 The PES aims to assess the magnitude of non-sampling errors in terms of i) coverage errors and ii) content errors (quality of census data collected).

Coverage errors

22.10 There are three types of coverage errors:

- ◆ omissions: some units, which belong to the population of interest, escape detection (resulting in under-coverage);
- ◆ duplications: some units, which belong to the population of interest, are counted more than once (resulting in over-coverage);
- ◆ erroneous inclusions: some units that do not have the characteristics necessary to be part of the population of interest are wrongly included or misclassified in the frame (resulting in over-coverage).

22.11 There may be errors in the listing of units which create errors in coverage. The omission of some units in the listing will lead to an underestimation of the totals for all characteristics, while duplication of holdings will lead to overestimation. Omissions are more common and, therefore, it is generally accepted that census estimates for most characteristics are biased downwards.

22.12 Coverage errors are very common whether the census is based on a sample or on a complete enumeration. They might appear because of difficulties connected with various characteristics of the enumeration area. If these are large in terms of area of the number of potential holdings, some holdings can easily be either omitted or listed several times. On the other hand, if they are small there is difficulty defining their borders. In the latter case, the enumerator may not know whether a particular potential holding unit belongs to his/her EA. Such misjudgement naturally leads to errors.

22.13 Accuracy of coverage depends on the distribution of units over the area of the enumerator's EA. Congestion of units often causes trouble. There may be a situation that two holders live in the same house sharing many of the common amenities, but operate land separately. Brothers living in the same house and sharing common facilities often operate land separately. The enumerator may, however, list them as operating only one agricultural holding. In such a situation data on the number of holdings is affected, and omission of data is very likely.

22.14 Coverage errors are also created when segments are prepared for identification because of the quality of related mapping materials. If the borders are not well defined and if there are no distinct identifiable landmarks on the ground separating two consecutive enumeration areas, the enumerator may find it difficult to determine whether a particular household should be interviewed or listed in this enumeration area.

22.15 When cadastral surveys have been conducted and maps prepared indicating the boundaries of the various areas such as villages, it is not difficult to demarcate the boundary of the two consecutive villages provided the enumerator is trained in reading cadastral maps. However, where the land has not been cadastrally surveyed and cadastral maps are not maintained, if well-defined boundaries identified on the ground are lacking, there is a great danger of making errors of omission or duplication of border units. This danger may reduce if GIS based maps are built-in the handheld devices when they are used for census taking.

22.16 The enumerators themselves represent another source of coverage errors. Some enumerators are careless and attempt to complete the work in haste. Some are not properly trained and do not know how to use existing facilities to prepare accurate lists. Some others may not be sufficiently interested in the work and do not clarify more complicated situations. Furthermore, the census field work is not an easy operation and enumerators may inadvertently omit some holdings.

Content errors

22.17 Content error is another serious non-sampling error. Sometimes under-reporting is due to fear of taxation, imposition of land tenure changes or reduction of subsidies. The nature of the inquiry may be cause for under-reporting. If holders do not keep records, it is difficult to get information such as production of crops, number of trees in orchards, area fertilised per crop, working time of household members and number of employees on the holding. Under-reporting is also very common in reporting livestock numbers.

22.18 Content error may be caused by poorly phrased questions and wrong interpretation of the questions, which shows the importance of pilot tests and focus groups to identify the best way to formulate the questions. Errors related to data transcription and coding can be quantified and the PES can also assess the magnitude of these errors.

22.19 In many developing countries, the quality of census data suffers because of the prevalence of a large number of different units of measurement for area and weight and occasionally standard units of measure are non-existent. In such cases the enumerator cannot easily convert local units into standard units.

22.20 The holders operating large holdings could forget to report all parcels of land operated. They generally operate land in several areas or villages and when reporting forget to give information on the parcels operated in villages other than the village in which they reside. When objective measurement of areas is applied, it is necessary that both enumerator and holder visit each parcel. They may intentionally fail to report distant parcels in order to avoid such a distant visit.

22.21 Missing data (item non-response) is a special kind of content error. This refers to a variety of situations. In case of crop-cutting, it may happen that the enumerator arrives after the field is already harvested. Refusals to report some of the questions also represent missing data.

Characteristics of a PES

22.22 PES is organized on a sample basis (see paragraphs xx-xx). The PES should be conducted qualitatively better than the census, and its cost and size would be relatively small.

22.23 The objective of the PES should be clearly outlined. The purpose will be to determine a quality measurement of the census data to provide such information to users of the data and plan better the next census. The PES data should not be used to adjust the census results. The data collected in the PES are from a small sample and cannot be used for such adjustments. Census results are presented for small administrative and geographical areas, while PES is not. Any adjustment based on PES data will introduce serious limitations in the use of census results as correction factors will be subject to large sampling errors. Such adjustments will also introduce internal inconsistency in the results. For instance, it has been found that if there is a serious error in the irrigated areas obtained from the census, any adjustment made in the irrigated area on the basis of the PES may introduce serious inconsistency in respect of total cropland. There may be some situations where common errors can be determined on the basis of the PES. For example, when area data have been reported in a particular local unit, physical measurement of area in the PES may provide a correction factor for adjusting the census results.

22.24 The utility of the PES for checking the quality of census data is of even more value in countries that are at the initial stages of statistical activities. In such countries there may not be check data to evaluate the consistency of census results.

22.25 Experience is needed to clarify the problems of conducting a census through a number of field investigations, and test how efficient are the methods that might be used. Systematic records kept on the origin of errors is an extremely valuable tool for planning future censuses and surveys (see Chapter 7). Statistically developed countries have a census methodology that has evolved through many surveys and

censuses. Developing countries will have to develop, through experience, census methodology suiting their own local socio-economic conditions. The organization of a PES is one of the important steps in that direction.

22.26 The use of the PES for checking quality may create pressure on respondents and enumerators to supply more accurate data. They will both be alert and conscious that data inaccuracies could be detected at a later time.

Planning the PES

22.27 The PES should be carefully planned and synchronized with the planning of the agricultural census. The plan for undertaking a PES should comprise:

- ◆ Definition of objectives and scope of the evaluation;
- ◆ Determination of the human resources needed and their qualifications;
- ◆ Assessment of availability of resources and determination of additional ones for undertaking the PES;
- ◆ Detailed budget and financial time-table;
- ◆ Operational time-table. The field work for the PES should be conducted as close to the finalization of the census field work as possible;
- ◆ Organizational structure;
- ◆ Communication and publicity ;
- ◆ Presentation of results, etc.

22.28 The following list of activities adapted from the UN PES Operational Guidelines (2010) serve for adequate planning of the PES:

Preparatory activities

- ◆ Compilation of sample EA maps for the PES;
- ◆ Plan for sampling design and estimation procedures;
- ◆ Development of a questionnaire;
- ◆ Drafting of manuals for the PES;
- ◆ Development of matching rules between holdings detected in the census and units in the PES;
- ◆ Production of a tabulation and analytical plans;
- ◆ Conducting a PES pre-test;
- ◆ From the test finalization of all materials and design.

Data collection related activities

- ◆ Conduct publicity campaigns;
- ◆ Recruitment and training of field staff;
- ◆ Data collection.

Matching units from the PES and the census

- ◆ Definition of ways to match units from the census and the PES;
- ◆ Development of computer programmes for matching (if digital matching is to be used);
- ◆ Development of guidelines for matching;
- ◆ Training of clerical staff to perform matching as required;
- ◆ Initial matching;
- ◆ Final matching after reconciliation results.

Field reconciliation (to resolve non-matched holdings)

- ◆ Developing guidelines for field reconciliation visits;
- ◆ Training for reconciliation visits;
- ◆ Carrying out the reconciliation visits;
- ◆ Final decisions of un-resolved cases, to establish matching status of cases.

Data processing

- ◆ Selection or development of computer programmes for data entry, tabulation and estimation
- ◆ Recruitment and training of data processing staff;
- ◆ Carrying out data entry, editing and tabulation.

Estimation of coverage and content errors

- ◆ Estimation of coverage;
- ◆ Estimation of content errors;
- ◆ Estimation of sampling error of the PES

Report preparation and dissemination

- ◆ Analysis of PES results;
- ◆ Preparation of PES analytical report;
- ◆ Dissemination of PES results.

Design of the PES

22.29 Questions arise on what the content of the PES should be, what the sample size should be, who should do the field work, and when the field work should be organized.

22.30 The first point to highlight is that the PES is an exercise that must be conducted independently from the agricultural census. Data collected in the PES need to be matched with data from the census to assess the census coverage. Besides, data about main key variables taken in the PES need to be compared with information for the same data for the same geographical area to evaluate quality of data content. Therefore the independence of both activities is critical. As a result, the PES cannot use holding's frames from the census, data or sources already used by the census or the same enumerators/supervisors in the same EAs.

22.31 The most common probabilistic sampling design is based on two stages with stratification of the first stage units. The first stage sampling units are administrative or geographical units (provinces or districts) stratified according to a suitable variable (i.e. in proportion to the number of holdings known from the census or from previous surveys); the second-stage units are made up of areas (EAs or cadastral map sheets), which thus constitutes the sample frame. During the PES, the agricultural holdings in the selected areas must be identified and counted.

22.32 The size of the sample and its distribution will depend on financial resources available for this purpose. In practice, the frame of EAs used for the census is also used as a convenient frame for a PES. Alternatively, considering the importance of coverage errors and the fact that data on agricultural areas tend to be underestimated, geo-referencing tools (e.g. Google maps) are used instead in order to assess coverage and evaluate the frame used for the census. In its simplest form the PES would involve:

- ◆ selecting a sample of area units, such as administrative or geographical units (provinces or districts);
- ◆ preparing a new list of agricultural holdings in the selected areas (e.g. EAs);

- ◆ collecting relevant data on key selected variables of the census programme/questionnaire from a sub-sample of holdings; and
- ◆ estimating separately the under-coverage rate and the content error.

BOX 22.1 –Experience Nicaragua PES

The aim of the PES was to assess the quality (in terms of coverage) of the Fourth Agriculture Census (CENAGRO IV), 2011. Coverage refers to the percentage of existing farms on Nicaraguan territory that have been enumerated at the time of the census.

Sampling design: For the census the country was divided in 3,198 EAs distributed in 153 municipalities. In order to conduct the PES, 12 municipalities (total of 511 EA) were excluded from the sampling frame due to difficult access and low contribution to agriculture. Then, the sampling frame was composed by 2,687 EAs. The stratification criterion was applied by the high correlation between the size of farms and the percentage of coverage errors detected in the previous PES (Third Agriculture Census, 2001). Taking into consideration the sample size of the previous PES, the quality of the results and the available resources, a sample equal to 4% of the total EA was selected for the PES. Overall, the sample involved 100 EA for a total of 8,900 farms. The methodology for the selection of the EA was one-stage simple random sampling with proportional allocation in each stratum. During field operations all farms located within the selected EA were surveyed.

Results: In percentage terms, the under-coverage was estimated at 2.9% and the over-coverage in 2 percent. In terms of quality standards, these are highly acceptable at the international level.

For details please refer to

http://www.fao.org/fileadmin/templates/ess/ess_test_folder/World_Census_Agriculture/Country_info_2010/Reports/Reports_4/NIC_SPA_REP_2011.pdf

BOX 22.2 - Experience Thailand - Evaluation of census data

After the completion of census field work, NSO carried out the PES in order to evaluate the quality (both, coverage and response) of census data. The PES was conducted for all holdings in the selected EAs throughout the country.

Sampling design. Stratified Single-Stage Sampling was applied in the PES. That is, there were four strata referring to four regions – Central, North, Northeast and South and provinces in each region were represented as sub-strata. Within each sub-stratum, the EAs were systematically selected; the total sample size was 1,280 EAs. After the PES field operation, information between the census and the PES were processed for matching check on census coverage and census content, such as information on the agricultural activity engagement such as livestock, growing rice, planted rubberwood, planted permanent crops and field crops, etc.

For details please refer to:

http://www.fao.org/fileadmin/templates/ess/ess_test_folder/World_Census_Agriculture/Country_info_2010/Reports/Reports_5/THA_ENG_THA_PRE_REP_2013.pdf

Training for the PES

22.33 In order to assess the quality of census data, the results from the PES are compared with those from the census. Therefore, the main assumption behind the procedure is that data from the PES would be virtually free of errors. As a consequence, training for enumerators and supervisors of the PES must emphasize such aspect to ensure the best quality of data.

22.34 The enumerators for the PES play a very important role since, being a quality survey, they must operate in the most professional possible way in each operation of the data collection phase. Furthermore, they must be better trained and have specific knowledge of the agricultural world in terms

of official definitions of the variables considered. In order to guarantee the independence between the two operations (census and PES, as required), the best enumerators should be assigned to EAs other than those they worked during the census enumeration.

22.35 The areas sampled for the PES will be a few in comparison with the total number of EAs in the census. Therefore, staff involved in the PES will be a small number of persons compared with the volume of personnel mobilized during the main census work. As a result, the training for the PES may be conducted in one (or two) venues easing the knowledge transfer.

22.36 The staff required for undertaking the PES should be recruited from the most qualified and experienced staff who worked in the census. In view of the characteristics of the survey, the training should be carried out directly by the technical staff from the main census office involving classroom, and practical exercises and tests to assess the degree of learning.

22.37 The training for the PES should at least comprise the following subjects:

- ◆ Clear explanation of the purpose of the PES;
- ◆ Importance of the work and final results expected;
- ◆ Survey methodology;
- ◆ Organization;
- ◆ Filling of PES questionnaire;
- ◆ Importance of collecting complete information from the questionnaire in order to facilitate matching of data: establishment of coordinates if GPS is used, detailed information about the holder's identification (names, surnames, alias, or ID number) and other information about the holding (postal address, holding name if any, precise location (community, district, municipality, village, settlement, etc.);
- ◆ Field exercise;
- ◆ Final quiz.

22.38 In addition to training days, appropriate tools to ensure online support during the survey are useful. For example, answers to questions about the management and technical aspects of the survey through the FAQ (Frequently Asked Questions); activation of email boxes and a dedicated help desk to meet real-time demands for clarification by the enumerators.

Data collection in PES

22.39 The PES should normally be a small sample survey carried out soon after the census enumeration is completed. In the cases of the modular and integrated sample/survey modalities, the PES could be conducted soon after the core module and the light census, respectively. The questionnaires to be used by the PES enumerators should deal with only a few key items from the census to check coverage and accuracy of responses. The preparation of a new list of units in the sample areas should be an integral part of the PES. As far as possible, the methods used for data collection should be more reliable than those used by census enumerators. By repeating the same questions and by following the same method of collecting data, there is hardly any possibility of discovering the errors in census data. If the census data has been obtained by the interview method, it would be best to check their quality by adopting some method of physical measurement. For a good quality check on census data, it is necessary to have the best enumerators and to adopt a very controlled technique. The use of physical measurement of area, and actual count of livestock and trees should be attempted. However, this is perhaps more appropriate for "stable" census items such as land area and the number of trees, and less appropriate for highly changeable items such as livestock heads. This is more the case when there is a cyclical nature to the production and what was present on the day of census enumeration may not be there on the PES day.

22.40 Volume I of the WCA 2020 encourages countries to move in the direction of using geo-coding systems such as direct geo-referencing of holdings by the use of GPS or cadastral maps (See Vol. 1, §8.1.4). If that was the case during the census taking the matching procedure which is the base for analysing the PES results would be greatly facilitated because the link reference would not be the holder's name and/or address or other personal identification reference but the exact coordinates of the holding.

22.41 The field operations of the PES should start as soon as the census enumeration is completed. Re-enumeration during the census to check data quality is possible and may be more economical but is not recommended because it is not possible to select the most qualified and experienced staff for this work. Conducting the PES soon after the census takes advantage of the atmosphere created for the census in securing people's willing cooperation. If it is conducted late, there is a danger of respondents forgetting many things. The longer the lapse between the census and the PES the more likely problems will arise.

22.42 The definition of the statistical unit (agricultural holding) of PES must be the same adopted by census. The PES reference period must be the same as the census.

22.43 The enumerator, during the data collection, can use the cartography of the EA (cadastral maps or other types of maps). In order to ensure the independence of the exercises it is advisable that the enumerator for the PES go to the field only with maps or satellite images but not with name or addresses of already taken in the census.

22.44 For each sampled EA, the data collection consists of two steps:

- ◆ **Step 1:** the identification of the agricultural holdings. The enumerator should list all agricultural holdings with agricultural area and/or livestock that, at the census reference date were totally or partially in the EA;
- ◆ **Step 2:** the enumerator interviews all the holders identified in step 1 using the PES questionnaire.

22.45 The list of agricultural holdings identified during the PES is obtained after the two steps described above.

22.46 The PES questionnaire is usually a subset of the census questionnaire. They include only those variables needed to establish the existence of a holding and eventually to identify it. The use of physical measurement of area, and actual count of livestock and trees should be attempted. As mentioned earlier, to the extent possible the methods used for data collection in the PES should be more reliable than those used in the census enumeration.

BOX 22.3 –Indonesia Experience -Post Enumeration Survey

Post enumeration survey (PES) estimated the size of non-sampling errors in the agricultural census. PES was undertaken to determine accuracy level of household coverage and accuracy level of questionnaire completion on characteristics of agricultural households and to assist data users in using the census data by providing comprehensive insight about the quality and limitations of census data. PES was carried out immediately after the completion of data collection and independently from the census enumeration. The coverage area of PES was all provinces with a total sample of 1,350 census blocks. Each team consists of one team leader and three enumerators that works in six sampled census blocks. They previously had been in charge in the census enumeration but within the different census blocks.

For details please refer to:

http://www.fao.org/fileadmin/templates/ess/ess_test_folder/World_Census_Agriculture/Country_info_2010/Reports/Reports_5/IND_ENG_IND_REP_2013.pdf

BOX 22.4 - Nicaragua 2011. Example of content of the PES questionnaire

Section 1: Identification and location of the agricultural holding.

- 1.1. Department/region
- 1.2. Municipality
- 1.3. District
- 1.4. Community/Settlement
- 1.5. Census of Agriculture Supervision Area
- 1.6. Census of Agriculture Enumeration Area
- 1.7. Ministry of Agriculture Production Sector
- 1.8. Stratum for the PES
- 1.9. Number of the agricultural holding (PES)
- 1.10. Name of the agricultural holding
- 1.11. Exact address of the agricultural holding: -Reference point or landmark; -Postal address

Section 2: Holder's identification and address

- 2.1. The informant is: 1) the agricultural holder; 2) Other person; 3) No informant
- 2.2. Please state name and surnames of the agricultural holder or firm/company name
- 2.3. Phone number; Mobile number; e-mail
- 2.4. Does the holder live permanently in the agricultural holding? (If "YES" skip to 3.1)
- 2.5. Exact address of the agricultural holder: -Reference point or landmark; -Postal address
- 2.6. Department/region
- 2.7. Municipality
- 2.8. District
- 2.9. Community/Settlement/Neighbourhood

Section 3: Census data verification

- 3.1. Total holding area;
- 3.2. Number of bovines on holding at the end of last May regardless ownership;
- 3.3. Number of swine on holding at the end of last May regardless ownership;
- 3.4. Number of poultry on holding at the end of last May regardless ownership.
- 3.5. Please refer name of holders operating the adjacent parcels inside the Enumeration Area to this parcel: by the North; by the East; by the South; by the West; by other reference.

Section 4: Administrative controls

Enumerator's name (PES); Supervisor's name (PES); Dates of interview and supervision.

Analysis of PES results

22.47 When the PES data collection phase is finished, two lists will be available for the sampled areas: holdings enumerated by the census (List A) and those enumerated by PES (List B). The purpose of the record linkage phase is to perform the matching between List A and List B; this step is fundamental since

it is necessary that the matching (also with the use of probabilistic linkage) is exact, i.e. a holding rightly covered by the census must match the same holding listed by the PES. The record linkage techniques applied to merge census and PES, are usually based on a probabilistic approach (Fellegi and Sunter, 1969; Winkler and Thibaudeau, 1990). An example of record linkage for matching holdings using open source software is RELAIS (REcord Linkage at Italian National Institute of Statistics -Istat).

22.48 Matching in this context is one of the more complex and challenging operations. Different situations are found (2010 WPHC, p. 54):

- ◆ If only name and address of the agricultural holder and name, address and geographical location of the agricultural holding were taken during the census, matching is more difficult. Names sometimes are spelled different, the name reported in one operation can be a “second name” or an “alias” different than the name provided during the other operation, the same address may correspond to different holders and so on. For that reason the more information about identification of holders and holdings is taken the better the record linkage can be. It is recommended that the questionnaire for the PES investigates other possible names and names of holders operating adjacent parcels. Identification of telephone numbers and addresses are also important for the matching exercise;
- ◆ If apart from names and addresses some unique personal identification (like the number in the National Identification Document) is available, the matching procedure will be easier and unclear or problematic cases reduce to a minimum;
- ◆ Finally if during the census, the holding was geo-referenced, the same procedure must be used in the PES for a more straightforward matching.

22.49 During the record linkage between lists A and B four cases can appear:

- ◆ If unit *a* in the PES (that should be censused) match unit *a* of the census, then “unit *a* was correctly included”;
- ◆ Unit *b* in the PES (that should be censused) did not match any unit in the census, then “unit *b* was omitted” (or incorrectly excluded);
- ◆ Unit *c* in the census did not match any unit in the PES (unit *c* was not an agricultural holding), then “unit *c* was incorrectly included”;
- ◆ Unit *d* is neither in the census nor in the PES, then “unit *d* was correctly excluded”.

22.50 Case b indicates “under-coverage” while case c indicates “over-coverage”.

22.51 A particular situation occurs when a unit was rightly censused but it was assigned to an incorrect EA. If a particular unit belonging to EA “*x*” was incorrectly assigned in the census to EA “*y*” and EA “*x*” is selected for the PES, such unit would be reported in the PES as “omitted” because it does not match any unit of EA “*x*”. However, this is not a case of under-coverage because the unit was censused. On the other hand, if EA “*y*” (and not “*x*”) is selected for the PES sample, the (incorrectly located) unit will show in the census but not in the PES. Nevertheless, this is not a case of over-coverage. For these reasons it is advisable to extend the search of matching units to neighbouring EAs.

22.52 To assess the content errors of census data (the second objective of the PES) a few key variables are taken in the PES and the national values are estimated from the sample and compared with the data coming from the census, taking into consideration the sampling error. For instance, if the under-coverage of small holdings where poultry is concentrated is important, the estimated values from the PES most likely will indicate a sub-estimation of census data referred to the number of poultry (it means that estimated values from the PES will be greater than the national values from the census) but total area, perhaps will be not greatly affected (Forsman and Schreiner, 1991; Kasprzyk, 2005).

Presentation of PES results

22.53 As mentioned before, PES errors may be classified into two categories: (i) coverage errors and (ii) content errors. It may be emphasized at this stage that coverage errors in surveys and censuses affect the results more than any other factor. Bias due to either omission or duplication of units introduces errors in estimates of all characteristics. Of course, the magnitude of this bias will depend on the distribution of coverage errors. It may be large irrespective of whether omissions or duplications exist. However, in either case, it will be small if units affected contribute little to the total for the characteristics concerned.

Presenting coverage errors

22.54 At the end of record linkage phase it is possible to classify the agricultural holdings belonging to the areas covered by the PES, in:

- ◆ Listed in the census (N_{1+}): they can be seen as the sum of the number of holdings both in the census and in the PES (agreements) (N_{11}) plus the number of holdings in the census and not in the PES (erroneously included) (N_{12})
- ◆ Listed in the PES (N_{+1}): they can be separated in: listed in the PES and in the census (agreements) (N_{11}) plus the number of holdings listed in the PES but not in the census (erroneously excluded or omissions) (N_{21}).

22.55 That situation can be presented as shown in Table 22.1

Table 22.1. Distribution of surveyed (in) and non-surveyed (out) holdings at census and PES
PES (List B)

		In	Out	
Census (List A)	In	N_{11}	N_{12}	N_{1+}
	Out	N_{21}	N_{22}	N_{2+}
		N_{+1}	N_{+2}	N

22.56 From the above table the coverage rates are: the **coverage rate** is: $\tau_C = N_{1+} / N$; the **under-coverage rate** is: $\tau_{UC} = 1 - \tau_C$. Both values could be expressed in percentage multiplying by 100.

22.57 The simple presentation from Table 22.1 does not allow analyzing the coverage separating the effects of non-response from the errors coming from imperfect listing. Table 22.2 enables a deeper analysis of coverage errors. In order to do this, it is necessary to classify the holdings in the PES into those that did not respond the census because of contact failure (due to refusals or unavailability of respondents) and those omitted in the census for other reasons (e.g. listing error). This is not an easy task. More details are available at USDA (2007), Wolter K. (1986) and Zarkovich, 1963.

Table 22.2 Coverage errors by main source

	N_{1+}	N	τ_C (%)	τ_{uc} (%)	
				Non-response errors	Errors list
Size classification of holdings (in ha)					
Territorial domains (i.e. country, regions, districts, etc.)					

Presenting content errors

22.58 A critical study of various tables will give an excellent insight into the quality of data collected in the census. Data for various size classes point out what categories of holdings are most affected by data quality and where attention should be directed in future censuses to ensure higher quality. Content error is estimated only for matched holdings and for selected variables, such as area, number of livestock and trees, etc. Each statistician responsible for planning the agricultural census should know what extent the coverage and content errors for various characteristics could be surveyed, and whether these errors can be overlooked without risk of major biases (see Cochran, 1977 and Särndal et al., 1992).

References and suggested reading

For more details on non-sampling errors, please refer to:

Jeremiah P. Banda (2003), *Non sampling errors in surveys* – Draft - ESA/STAT/AC.93/7.

(http://unstats.un.org/unsd/demographic/meetings/egm/Sampling_1203/docs/no_7.pdf);

Carol C. House, *Statistical Aspects of a Census*. Paper presented at the Conference on Agricultural and Environmental Statistical Applications in Rome (CAESAR), June 5-7, 2001.

([http://www.nass.usda.gov/Education_and_Outreach/Reports, Presentations and Conferences/allreports/Statistical Aspects of a Census.pdf](http://www.nass.usda.gov/Education_and_Outreach/Reports,_Presentations_and_Conferences/allreports/Statistical_Aspects_of_a_Census.pdf));

Post Enumeration Surveys Operational Guidelines, United Nations, New York, April 2010

http://unstats.un.org/unsd/demographic/standmeth/handbooks/Manual_PESen.pdf

“Non Sampling Errors in Surveys”, J.T. Lessler and WD Kalsbeek, Wiley Series in Probability and Mathematical Statistics, John Wiley & Sons, 1992.

R M Groves, *Survey errors and survey costs*, John Wiley & Sons, 2004.

Post Enumeration Surveys Operational Guidelines, United Nations, New York, April 2010

http://unstats.un.org/unsd/demographic/standmeth/handbooks/Manual_PESen.pdf

Bernardini, De Gaetano, Mazziotta, Soriani, The Coverage Survey of the 6th Agricultural Census, Paper presented at the Italian Statistical Society (SIS) Scientific Meeting 2012.

(<http://meetings.sis-statistica.org/index.php/sm/sm2012/paper/view/2175/119>).

I.P. Fellegi, A.B. Sunter (1969), “A Theory for Record linkage”, *Journal of the American Statistical Association*, 64, pp. 1183-1210.

(<http://courses.cs.washington.edu/courses/cse590q/04au/papers/Felligi69.pdf>),

William E. Winkler and Yves Thibaudeau, *An application of the Fellegi-Sunter model of record linkage to the 1990 U.S. decennial census*, U.S. Bureau of the Census.

(<https://www.census.gov/srd/papers/pdf/rr91-9.pdf>)

Italian National Institute of Statistics (Istat). RELAIS (REcord Linkage at Istat)

<http://www.istat.it/en/tools/methods-and-it-tools/processing-tools/relais>.

G. Forsman, I. Schreiner (1991), The Design and Analysis of Re-interview: an Overview, in: *Measurement Errors in Survey*, P. Biemer, R.M. Groves, L. Lyberg, N. Mathiowetz and S. Sudman (eds), New York, Wiley, 279-302.

(http://unstats.un.org/unsd/hhsurveys/pdf/chapter_9.pdf)

Daniel Kasprzyk (2005), Measurement error in household surveys: sources and measurement, Chapter IX in *Household Sample Surveys in Developing and Transition Countries*, Department of Economic and Social Affairs Statistics Division Studies in Methods Series F No. 96. United Nations, New York.

United States Department of Agriculture, *Census of Agriculture 2007* (Appendix A, page A-14, table A)

http://www.agcensus.usda.gov/Publications/2007/Full_Report/usv1.pdf

Wolter K. (1986), Some Coverage Error Models for Census Data, *Journal of the American Statistical Association*, Vol 81, No.394, pp. 338-346. (<http://www.old.sis-statistica.org/files/pdf/atti/RSMi0602p283-286.pdf>)

SS Zarkovich “Quality of Statistical Data”, FAO, Rome, 1963

Cochran W.G. (1977), *Sampling Techniques*, Wiley, New York;

Särndal C.E., Swensson B., Wretman J. (1992), *Model Assisted Survey Sampling*, Springer-Verlag, New York.

CHAPTER 23 DATA ANALYSIS, REPORTING AND DISSEMINATION

Introduction

23.1 As mentioned earlier, the agricultural census is one of countries' largest and costly statistical operations. Its value and justification are in the wide range of data uses, not only for public policy decision-making but also for private use and general knowledge, etc. Providing accurate and timely data to users is a matter of great importance and should drive all the census process. Data from national censuses represent a valuable public good that should be widely promoted by national census offices in order to enhance its utilization by the various users. Thus, census should not be an end in itself but be backed by the value of the results, in terms of utilization, by the diverse categories of data users. Therefore, the dissemination process should be well organized and discussed with stakeholders and primary data users within the census committee and with other groups of users during the preparatory phase.

23.2 Traditionally, the main vehicle for access to results is through published reports. However, the last decades have seen a tremendous development in Information and Communication Technology which allow new and more diversified methods of dissemination and access to census results. One of the duties of the unit responsible for dissemination of census data is to make the best use of both traditional and new dissemination methods. Wider and user-friendly access to census data will be of paramount importance in coming years for contributing to monitoring of SDG goals and informing national and regional policy decisions.

23.3 Although the tendency is to plan to provide complete and accurate results, the importance of the time factor should be kept in mind because the usefulness of statistical information decreases in proportion to the length of time taken to provide it. Census managers should always search for the optimum compromise between an ambitious dissemination programme and a quick but definitive release of the main results. In fact, the dissemination should be seen (and thought of) as a dynamic process between these two extremes.

23.4 Along with the preparation of a work plan for the various census operations, a dissemination strategy with detailed plan should also be prepared and adequate resources allocated at the outset of census preparation.

Dissemination strategy

23.5 A wide range of dissemination strategy options must be developed for meeting the requirements of different users. Appropriate technologies and media need to be identified for effective and user-friendly dissemination of census data and information. A number of key elements should be taken into account in the development of a strategy for census data dissemination, including: (i) identifying the diverse categories of users and their data needs/uses through consultation, (ii) products to be developed, (iii) the

media of dissemination, (iv) meta-data to aid in the interpretation of the results, (v) confidentiality and privacy measures, (vi) assessing the required technologies to meet user needs, (vii) dissemination policy, (viii) quality assurance in terms of accuracy and timeliness, and (ix) available financial and human resources.

23.6 The main purpose of the dissemination strategy is to ensure a wide use of census results by a large range of users and the public in general. Proper communication campaign will contribute significantly to keeping users informed of the development of the census operation and availability of results.

23.7 Experience shows that in many countries there is an unbalance in efforts and resources allocated to technical preparation of census, field data collection and processing on the one side and data analysis, reporting and dissemination on the other side. Therefore, census managers should ensure that at the phase of census planning and budgeting, adequate financial and human resources are set aside for data dissemination. The dissemination strategy should be complemented by a detailed dissemination plan.

Dissemination plan

23.8 The dissemination plan covers the census products, services, methods and tools planned by census agency for the dissemination of preliminary and final census results to suit the requirements of different types of users.

23.9 The information of the users and public about the census is the first element of the dissemination plan. The publicity campaign should have made people aware of the census as discussed in section 3.4. Once curiosity has been created in the public's mind, they are expecting and looking for census results and the primary data users keenly await the publication of the census results.

23.10 It is very important to bring to the public's attention data available from the census. The public may not remember having participated in an enumeration which possibly took place some time ago. To implement a new and short campaign of information is best done by orientation toward the presentation of national results: for number of holders, number of livestock, size of agricultural land, importance of the agricultural sector in the country, trends and changes since the previous census, etc. Generally, the media are eager to receive this kind of information and the opportunity should be taken with these messages to make it known that the census dissemination process is now under way. Presentation of census results might be done on radio, television or web streaming by a High level Government officer (Minister of Agriculture, Planning, Finance etc., depending who is in charge of the census organization).

23.11 A standard dissemination plan should be developed as part of census preparation, including development of output systems, dissemination products, management of the release, keeping users continuously informed of the census development. A variety of census products can be disseminated which are tailored to meet the needs of the particular type of user. For example, policy users in government may require that the results be analysed (e.g. through analytical/thematic reports) and include basic focused summaries of key changes and problem areas relevant to the agricultural policy of interest, with accompanying graphics and appropriate analysis. On the other hand, the needs of users such as researchers may be met by providing access to as many of the detailed data tables in electronic formats as is possible, even to anonymized microdata, according to national legal provisions and ensuring safe access to them. The products should include both public use products as well as specific products for internal agency use.

23.12 The dissemination plan may include the following products, services, dissemination methods and tools, which are described below:

Products and services

Reports

- Report on preliminary results
- Report on final results
- Thematic reports
- Report on quality evaluation (including results of PES)
- Technical report

Data products and services

- Tabulated data
- Providing access to macro-databases and to micro-databases

Other products

- Atlases and other geographic products
- Brochures and flyers
- Videos, sketches and on-line videos, etc.

Methods and tools for dissemination

Printed materials

Online dissemination

Other electronic methods

Methods and tools for safe access to microdata

23.13 Another important activity is the preparation of a catalogue designed to present the publication plan of the dissemination products mentioned above, the date of issue of each product, the price and the size, addresses where they can be bought or ordered, summaries of contents and even order forms. This document should be issued as early as possible and as soon as the dissemination plan is finalized, and then widely distributed, particularly during the campaign mentioned above. The on-line/computer media releases may also be announced as part of the catalogue. These would include safe access to microdata, additional tabulations, etc., on flash drives, compact discs, or direct access, other electronic media and/or in the web as discussed later in the section on other kinds of dissemination. The catalogue is an official commitment of the census agency and a maximum effort should be made to meet this commitment.

23.14 The dissemination plan should also include the development and dissemination of metadata. It is important to provide a description of the aggregation and retrieval systems used to compile the basic tabulations and references to the use of these systems. The methodology for producing each dataset should also be completely documented and provided to users as needed.

23.15 Explanatory notes should be provided in all releases of information to ensure that users of the census data are aware of the following:

- ◆ The scope and coverage of the census;
- ◆ Main concepts and definitions used in the publication (including the statistical unit) and any limitations affecting the accuracy of the data;
- ◆ Important information about the census methodology (use of a complete enumeration, sample enumeration or the combination of both, reference period, enumeration method used, etc.).

23.16 Opportunities to participate in seminars, conferences, lectures and talks on various media are often offered to census staff to present and enhance the value of information provided by the census and other parts of the statistical system. Such talks, if carefully prepared, are an efficient means of attracting interest for census data. This should be considered as an important part of the dissemination process by those associated with the census.

23.17 The publicity for promoting the use of census results should take into account that the primary users are:

- ◆ Officials of the national government involved in planning, policy, programme evaluation, etc.
- ◆ Officials of local governments (interested particularly in detailed data for small areas).
- ◆ Agencies involved in current agricultural and rural surveys.
- ◆ International organizations such as FAO, World Bank, etc., concerned with development planning (very important users in developing countries).
- ◆ Business, farm organizations, research organizations, academia, media, etc.

23.18 Knowledge of potential users and their use of census data is important, not only for the orientation of the publicity campaign but even more so for planning the dissemination programme, including decisions on the number of copies required of each report and their prices.

23.19 The census results can be published as reports for general distribution, tables, maps, atlases, and other census products or by allowing for ad hoc user-generated requests through access to macro- and micro- databases. The nature and content of dissemination products and services, as well as of the dissemination methods and tools are described below.

Dissemination products, services, methods and tools

Dissemination products and services

Reports

23.20 The reports are traditional and most common dissemination products. These can include the reports on preliminary and final results, analytical reports, quality evaluation, technical and other reports.

Reports on preliminary results

23.21 To maximize the benefits of the census, the results should be disseminated sequentially. A short preliminary report with advance results should be issued as early as practical. According to best practices, countries release the first preliminary census results within 3 months after the end of the enumeration period and/or 6 months after the end of the census reference period¹¹¹. Both online and printed dissemination media can be used for dissemination of preliminary census results.

¹¹¹ Such a time lag between the release of preliminary census results and the end of the data collection period (no more than 3 months) or of the reference period (no more than 6 months) was achieved in countries like Estonia, Finland, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, Sweden. Data source: Census National Methodology Reports 2010: <http://ec.europa.eu/eurostat/web/agriculture/national-methodology-reports>

23.22 In the modular and integrated census and survey modalities the release of preliminary census results can be done after the implementation of the core module. A preliminary report may include only selected priority results, such as number of agricultural holdings, area of agricultural land, number of livestock by main types, etc., showing mainly totals, without cross-tabulations. These results are usually presented at national and major administrative division levels. The importance of the items will vary from country to country, and, therefore, they normally should be chosen for advance tabulation in consultation with the Agricultural Census Steering Committee. Advance estimates of some basic characteristics of holdings may be useful to persons actively engaged in the process of planning agricultural development programmes and intimately connected with the formulation of the census operations. There are other groups, like research workers, agro-industrialists, agricultural input manufacturers, etc., who are equally interested in the results of the census.

23.23 The advance estimates of principal characteristics of the holdings are provisional and subject to revision once the full data-processing and verification operations have been completed. As discussed in Chapter 6 these could be based on:

- a) all the holdings enumerated in the census, or
- b) a subset of the census data, either a representative sample¹¹² or a geographic subset¹¹³.

23.24 The first case (a) above represent an efficient process for developing quick provisional results, based on automatic tabulations (e.g. when CASI or CAPI is used) or through primary manual tabulations (when PAPI is used). In the latter case¹¹⁴, field supervisors prepare totals for the most important characteristics at the end of field enumeration as a part of their report. This can be done with special forms, normally one line for each agricultural holding. Higher-level supervisors should make aggregates for their areas. Provisional census results may be processed manually (using a simple calculator) or/and by computer. For reasons of efficiency and reliability, the use of computers is always preferable. The ability to verify data quality during the enumeration phase with the help of validation programs, quick indicator reports, data consistency reports, and tabulations greatly increases the confidence with which provisional results can be announced.

Country example (Lithuania, Romania) - Links

23.25 In the latter case (b) a sample of holdings is chosen for this purpose and the results released for the country as a whole or for some broad administrative areas based on the geographic subset. The users of such results should be cautioned that such data are preliminary and subject to various sampling errors.

23.26 If the census is based on a sample, advance preliminary estimates for principal characteristics of holdings may be calculated by selecting a suitable sub-sample from the sample chosen for the census. Here also, limitations of such estimates should be mentioned, e.g. as a footnote so the user is aware of these limitations when using them.

Country example (Hungary) - Links

¹¹² Advance estimates based on a representative sample of principal characteristics of the holdings were produced and disseminated in countries such as Germany, Hungary, etc.

¹¹³ Some countries may wish to provide preliminary data for the main agricultural regions in advance without waiting for data for all regions

¹¹⁴ Preliminary results based on primary manual tabulations were compiled in countries such as Armenia, Moldova, Romania, Russia.

23.27 One way of advancing the release date of census results is the direct reproduction of computer printouts or online posting of preliminary results, which is increasingly used. However, this requires a very thorough testing of computer programs for tabulation in view of the need for high quality presentation of tables. It also requires complete editing and validation of data in order to produce consistent and well-balanced tables where all horizontal and vertical totals agree. In practical situations, last-minute changes on final tables are sometimes required. Whatever software is used for data tabulation, final tables can be transferred to an appropriate software which makes possible final improvements of the table lay-out and last-minute data changes.

23.28 The period for releasing the preliminary results after completion of the field work will be different for each country. It will depend on the number of holdings enumerated, number of items included, method of census enumeration, strength of the technical personnel, the data processing equipment that is available, etc. The use of CAPI would facilitate significantly the production and release of timely preliminary results.

23.29 However, the preliminary census results should be released not later than a few months after completion of the field work. If it takes longer, the urgent need for census information is left unsatisfied and the practical usefulness of the census is seriously diminished. In any case, the follow-up publicity campaign promoting the use of the census results, described above, should not be implemented before important results are available.

23.30 Often the users ignore the fact that results reported in the preliminary report are provisional and subject to revision. They may even forget that estimates are not always based on data from all holdings enumerated in the census. Since provisional and final results may differ (for example, the summaries on which provisional results were based might contain errors identified and corrected at the data processing stage), it is important that data users be made aware of and warned about the possibility of such differences. The release of preliminary census results should be part of the overall revision policy of the census agency. Along with a report countries may wish to produce other census products with preliminary census results, such as flyers.

Reports on final results

23.31 The final census results will be the output of the tabulation plan and must be published as soon as possible, insuring the reliability of the census results. According to good practices, countries release the final census results within two years after the end of the census reference period¹¹⁵. The use of technology reduces the time needed for the release of the provisional, as well as of the final results.

23.32 The reports on preliminary and final census results should be prepared by professional staff and, if possible, reviewed by experts familiar with the agricultural situation of the country. The report may be issued in a number of volumes, depending on the size of the country and contents of the report for example on:

- ◆ on a subject basis, e.g. one volume for general characteristics of the holdings, another for land use, another for livestock, another for equipment, etc. and/or
- ◆ a geographical/administrative basis, e.g. one volume for each province.

23.33 In addition to the report on all agricultural holdings, a final report for large (or commercial holdings) could also be produced, especially if census was conducted using a specific questionnaire for

¹¹⁵ Such a timeliness of the release of the final census results (no more than 24 months after the end of the reference period) was achieved in countries like Austria, Bulgaria, Greece, Czech Republic, Estonia, Finland, France, Hungary, Germany, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Sweden, USA, etc.

such units. If a community survey was conducted along with the agricultural census, a respective report with the final results should also be produced. For countries using the modular approach (or integrated census/survey modality) there should be reports on final results for the core module and for each supplementary module (or for the light census and rotated modules correspondingly).

23.34 The report should not be burdened with technical details but, in addition to numerous statistical tables, as well as graphs and maps it should include information on methodological, organizational and administrative aspects of the census which might be useful for better understanding and use of the data.

23.35 Thus, the report on final results could deal with the following:

I. GENERAL PART¹¹⁶

- ◆ Objectives of the census.
- ◆ Historical background: a brief history of previous censuses.
- ◆ A brief description of the country, e.g.: geographical area, agro-ecological zones and/or other geographic areas used to present census results; importance of agriculture and relationship of agriculture with other sectors of the economy.
- ◆ Census scope and coverage.
- ◆ Census methodology, encompassing, frame issues, sampling design and methodology (if applicable), and organization: a short summary.
- ◆ Main concepts and definitions, including the definition of the statistical unit.
- ◆ Census enumeration period and reference period/date.

II. RESULTS

- ◆ Summary of results. Important results will be summarized highlighting the salient features.
- ◆ Explanations for use of tables (if any).
- ◆ Basic (standard) tables (discussed in Chapter 6 “Tabulation plan”).

III. ANNEXES

- ◆ Some annexes such as census questionnaire(s), instructions, maps, etc. will be included.

23.36 Undoubtedly, a good final report on an agricultural census is a product of a thorough and quantitative knowledge of national agriculture. Sometimes, experts are employed as consultants for a short period to give an appropriate interpretation of census data. In order to make this work possible it is essential to provide sufficient funds in the census budget for the analysis of the census data and the preparation of a good report.

23.37 If the census has been conducted on a complete enumeration basis, obviously with the objective of presenting the census results at the smallest administrative level, producing a census report with such details is a very difficult and arduous task. The report will become unwieldy in size. Moreover, individual users will be interested in detailed data for specific areas only. This is a case where the report might be split into different volumes, each volume serving the interests of different groups of people or administrative units/localities. This becomes a major issue in large countries. However, advanced technologies make this task possible through large dissemination of geographic products and other data in a digital format (for more details see paragraphs **23.66 - 23.73**).

Box 23.1 Country example: India- Report on final census results

In India, the results of the agricultural census are published in several volumes. The All-India report gives summary results for the country as a whole as well as for individual States of the Union, while separate reports are produced for individual States. The State report presents detailed data for the individual districts. Otherwise, the format of the All-India report and that of individual States is the same.

23.38 No uniform method is suggested for all countries nor whether the census results should be produced in one or many volumes. It depends on the scope and coverage, the size of the country, the methodology used and the plans to disseminate data, and the format (printed or electronic). The report should be prepared keeping in mind the users' interest. The size of the report should be such that readers do not find difficulty in handling it and it should not be forgotten that the preparation of a good report requires adequate time, personnel and financial resources.

Analytical/Thematic reports

23.39 Analytical census products encompass a variety of possible outputs. Traditionally, these products have been analytical, particularly thematic reports that examine the patterns and characteristics of the census data in long-form writing. These reports help user community to focus their attention on critical issues and national priorities in agricultural and rural sectors. Analytical reports add value to the census data and increase their relevance and usefulness for policy makers and the public in general.

23.40 The analytical/thematic reports must be planned and scheduled during the preparatory phase and published according to the release calendar in order to secure the necessary funding and avoid out-dated reports. The reports may range from volumes presenting extensive and detailed statistical tabulations, particularly cross-tabulations, to more analytical reports that combine tabular materials with some interpretative or analytical text. This latter group of reports might include, for example, volumes of regional analysis on such topics as typology of agricultural holdings and their regional distribution; production methods used in agricultural sector; gender and other socio-demographic aspects of the holdings, land use, crops, livestock, work on the holding, input use, etc. Other such reports might include community profile analysis (when community level data are available, especially when a community survey has been conducted). It should be pointed out that it is important that appropriate language is used to correspond to the target audience for thematic reports. It is recommended that multidisciplinary task teams be established including line ministries and agencies for the preparation of thematic/analytical reports. Partnership and external cooperation with academic institutions and other specialists in subject matter can facilitate such work and strengthen collaborations.

23.41 Thematic/analytical reports must be based on user needs and respond to a country's specific development needs and emerging issues. These reports can also be used to show time series and trends analyses of main census items and may combine census data with other data sources to provide a more comprehensive and current outlook.

Technical report

23.42 A technical report is aimed at describing in detail how the whole census operation has been conducted, the methodology, choices made, concepts and definitions applied, difficulties encountered, possible delays and their reasons, the results of quality evaluation, etc., and to use this evaluation for making recommendations for future censuses. A technical report should include an evaluation of problems met, mistakes made and solutions found, and may include many confidential elements. It can contain also copies of all correspondence (letters at central and regional level, internal instructions, minutes of meeting of all census committees, etc) Furthermore, one of the purposes is to record the present experiences with census organisation for future internal use; consequently, it may be preferable not to publish whole report but reproduce only a few copies. Taking these factors into account the following approaches might be chosen: to include a summary of technical information in the final report mentioned above; to prepare a separate, more detailed, technical report for public use; and to prepare a detailed technical report including confidential information for internal use only. In any case, without a systematically prepared report the experiences gained and lessons learned in a census may be forgotten and the organization of the next census may mean a new and independent effort starting from scratch.

23.43 The following guidelines are suggested for preparing this technical report.

Introduction. This should give a complete overview of the census, lessons learned, if any, from previous surveys and censuses, and data gaps filled.

Approach to census methodology. This should describe the principal factors affecting the methodology of the census, census legal and institutional framework, types and details of data required by users, availability of farm registers, other statistical and administrative data sources to provide census items and prepare the census frame, availability of personnel, means of transport and communications, funds, agricultural practices in the country, current agricultural statistics and their relationship with the census, etc. An important section should be devoted to concepts and definitions used for the census of agriculture, with the options discussed and reasons leading to choose the preferred option (example, threshold for inclusion of agricultural holding into the census population, basis of determine it – economic, physical, calculations made)

Pre-field-work preparation. This should describe the basic principles adopted in the formulation of census questionnaires and instruction manuals; conduct of pre-testing and pilot census and discussions of salient results which affected the technical programme of the main census; segmentation of the country into enumeration areas and preparation of maps; preparation of frame; and training of personnel.

Field-work. This may explain the methods adopted in the collection of data such as self-enumeration, interview, objective measurement, use of PAPI, CAPI or CASI enumeration methods, etc.; advantages and short-comings of each method, and place of enumeration; schedule of field work such as number, timing and duration of field visits to collect different information, distribution of enumerators and their workload and various phases of field work; supervision, report on method of inspecting field work; and arrangement for collecting the completed questionnaires, monitoring of information.

Use of sampling methods (if applicable). This should discuss the sample design, giving details of the units of sampling, use of stratification and results achieved, choice of units at different stages in multi-stage designs, methods of selection of sampling units, and sampling fractions; estimation procedures;

combination of complete and sample enumeration; broadening the scope of the census through the collection of more detailed data from a sample of holdings in complete enumeration censuses (from a sub-sample of holdings in the case of sample enumeration), use of objective methods of measurement from a sample or sub-sample of holdings, use of supplementary modules (in the modular census) or rotating modules (in the integrated census/survey modality, study of seasonal variations through the sample survey programmes, etc.; sample tabulations describing the method of calculation of advanced estimates, estimations of sampling errors of estimates of different census characteristics, use of inter-penetrating sub-sampling schemes for calculation of sampling errors, etc.

Data processing. This should describe the whole organization of data processing, starting with manual editing and coding, and continuing with a description of methods of data entry, computer editing and tabulation; details on hardware and software used should also be given, as well as information on the level of decentralization of data processing, use of computer equipment, use of inter-active editing, new methods applied, use of resources external to the census office, etc.

Quality evaluation of census results. This should provide the description of quality control techniques used, the results of the evaluation of census data, including the results of the post-enumeration survey, if conducted. The quality evaluation should be part of the Technical Report. The overall structure of the quality evaluation is described in paragraphs 23.46 - 23.48 below.

Suggestions for further tasks. On the basis of experience gained in the census, foreseeable problems for similar tasks should be listed. This section is considered to be very important as future progress and improvement will be based on what is done between the two consecutive censuses.

In addition to the narrative information, some countries may wish to include tables with main census results in annex of the technical report.

23.44 In countries which have achieved a sufficient level of statistical development and acquired significant experience in conducting censuses, it will not be difficult to satisfactorily tackle the problem of preparing a detailed report. Developing countries, which have just started developing a proper statistical system and which have limited experience of organizing large-scale census operations, must begin to think of preparing a detailed report on the census work proposed. However, irrespective of the level of statistical development in a country, it should be pointed out that documents on the various phases of census operations, including the problems and decisions made, must be collected as the work progresses. This approach simplifies the preparation of the technical report and ensures that the salient points and experiences are recorded while fresh in the minds of technical and field staff.

23.45 In order to compile the technical report, a standard template can be built to get a comprehensive assessment and inputs from all the structures of the census agency involved in census planning and implementation (methodology, data collection, processing, analysis, etc.) in an organized fashion. The meetings with all relevant managers could also be useful and a less formal way to obtain the key input required for the technical report and to reflect on good practices to keep and changes to implement for the next census.

23.46 The tradition of exchanging census reports, particularly between neighbouring countries, can serve a very useful purpose in their improvement. This gives countries with less experience in preparing reports the benefit of the techniques followed by more experienced countries. A wider circulation of reports will also foster exchange of experiences and enhance the improvement of statistical practices in the field of agriculture.

Quality evaluation of the census results

23.47 The need for quality evaluation throughout the census implementation, including PES is discussed in Chapter 7 “Quality assurance framework” and in Chapter 22 “Post-enumeration survey”. The section on quality evaluation in the technical report should provide information on all quality dimensions of census data, as described in Chapter 7. The census usually collects data from all agricultural holdings (when complete enumeration is applied) according to the adopted definition, and thus there is no sampling error. The dimension on accuracy and reliability, should focus on the evaluation of non-sampling errors, including the assessment of:

- ◆ Coverage error, both under-coverage and over-coverage, and double counts;
- ◆ Measurement errors related to data collection stage. In most countries this along with coverage errors mentioned above is done via a post-enumeration survey (see Chapter 22);
- ◆ Non-response rates and imputation rates;
- ◆ Processing errors, including data capture or coding error rates;

23.48 Therefore, it will require special effort to finalize the assessment of the accuracy of census results in due time to permit incorporating the findings in the reports with final census results and to include the quality evaluation in the technical report on census methodology.

23.49 The quality evaluation can be presented in two parts. The first general part may describe the overall quality assurance framework adopted for the census (see Chapter 7). Quality assurance framework), quality control techniques used, including PES design and organization, sample used for PES, and way of selection of units; supporting evidence regarding the quality of data collected; description of tables presented; interpretation of data and their use; and conclusion. The second technical part may contain sections on the purpose of the quality control; efficiency studies; supporting evidence on quality of check data, including tables with comparison of aggregated data from census with other sources; information on the 6 quality dimensions (see Chapter 7) with their indicators, with special attention to the indicators listed in paragraph 50; analysis of errors and biases; suggestions for improvement; problems needing further study; efficiency considerations; and suggestions for the improvement of future quality control techniques. The appendix to the report might contain the PES questionnaire, field instructions, instructions for measurement, etc.

23.50 The census reports and other census products can be greatly enhanced by the addition of well-designed graphs, infographics and maps to increase the readability and comprehensibility of the key message graphs, maps and infographics.

Box 23.2 ESS Standard for Quality Reports Structure (ESQRS)

An example of a comprehensive and structured Technical report for statistical activities, including quality evaluation is the European Statistical System (ESS) standard for quality report structure. This is a standard structure for the collection of quality report has been built and is called ESS Standard for Quality Reports Structure (ESQRS) ([Link to ESQRS: http://ec.europa.eu/eurostat/documents/3859598/5909785/KS-RA-08-015-EN.PDF/4d9a6bfe-c072-477a-add4-3bda0ef00f95](http://ec.europa.eu/eurostat/documents/3859598/5909785/KS-RA-08-015-EN.PDF/4d9a6bfe-c072-477a-add4-3bda0ef00f95)). The ESS handbook for quality reports (Eurostat 2014) gives more information on definitions to be used and calculation of quality indicators (available at: <http://ec.europa.eu/eurostat/documents/3859598/6651706/KS-GQ-15-003-EN-N.pdf>).

Country examples of census technical reports (Congo Republic of, Portugal) – Links:

http://ec.europa.eu/eurostat/cache/metadata/EN/ef_esqrs_pt.htm

<http://ec.europa.eu/eurostat/web/agriculture/national-methodology-reports>

Data products and services

Tabulated data

23.51 Tabulated data are one of the primary products from a census and must respond to the needs of data users.¹¹⁷ The tabulations should be presented and explained in a way that will facilitate their extensive use. The data should be shown for appropriate administrative, statistical and other geographical areas and classified according to various characteristics.

23.52 Standard tabulated products (standard tables) are designed according to the Tabulation plan. These should provide basic tabulations and cross-tabulations and satisfy the majority of census data users. The recommended tabulation classes and cross tabulations and other details regarding the production of tables, particularly of standard tables are presented in Chapter 6 “Tabulation plan” and in the Chapter 10 of the Volume 1.

23.53 Additional tables based on specific users’ requests may require customized tabulations. Customized output is provided for users whose requirements are more specialized and cannot be satisfied by standard tabulations. These users provide the specifications for the tabulations they require, and the data output is produced on a consultancy basis. In order to meet the demand for customized output, it is useful to establish an “on request” service for users who require aggregates not available through other means. The service would require that users provide the details of the requested tables so that the census office could fulfill the demand, possibly against payment of a certain compensation fee. Offering and promoting this service, especially on-line, would place the statistical service in a more desirable proactive position, rather than a static one, and could be a strong catalyst for closer cooperation with census product users.

23.54 All tabulated data products should undergo a thorough internal quality review by subject matter experts prior to release, preferably experts not involved in the production of the product.

23.55 Special tabulations requested by users could be provided by census agency as soon as the census database has been established and tabulation software packages introduced. These packages allow fast and relatively inexpensive production of tables for selected subsets of the total database or for alternative aggregates, assuming the information has been preserved in the database in terms of the needed detailed classifications.

Providing access to macro-database and micro-database

23.56 Both micro- and macro-data structured in databases are at the basis of tabulated data and other dissemination products produced by census offices. In order to expand the life and usability of the data, and as a complement to the standard production of tables, national census agencies store the census data in various computerized database forms so as to better satisfy the full range of needs of internal

and external data users. A database is an ideal storage platform for structured data products from censuses. These are designed to store and retrieve data efficiently and quickly. Census databases with public access assist data users by providing easy access to a wide range of census data.

23.57 Needs vary widely from user to user according to specific interests and circumstances, as well as the institutional, technical, human and financial capacities of the census agency to address users' expectations to provide large access to census data in a user-friendly manner. There is therefore no preferred approach to setting up an agricultural census database. A basic decision must be made whether to provide access to macro-database, to micro-data (micro-data base), or both. Since building a census database requires careful planning and can be time/resource consuming, such implementation should fit within the global ICT framework of the organization, and be seen as an ongoing process both complementing the data dissemination strategy and strengthening the statistical capacity of the organization.

Providing access to macro-databases

23.58 Macro-data are stored to preserve earlier aggregations, to provide the broad public with readily usable information, and to prevent double work by those who may find that the summary data they require have already been produced. These data can be stored in many formats, either as the results for one census, as a database covering more than one census, or in a broad database of statistical information.

23.59 The simplest form of a database for macro-data is a straight copy of a publication on a digital medium, usually on the website of the census office, on an optical disk (CD-ROM or DVD-ROM) and/or on a Flash Drive. A machine-readable publication-equivalent database may have the advantage of being less expensive to prepare than its hard copy counterpart. In addition, electronic or paper copies can be made quickly, with copying of only part of the publication.

23.60 More advanced users may prefer that a census database of macro-data offer more than an equivalent of the printed publication. They might like to be able to manipulate the tables in various ways in order to obtain views or results that represent their specific requirements more precisely. Associated graphing and thematic mapping capabilities may also be welcome.

23.61 Commonly an appropriate software will give users access to a number of operations that process the table or several tables at the same time. Examples of such operations are reclassifying a variable (for example, to aggregate several area size classes into one), eliminating a dimension from a multidimensional table or joining tables that have a dimension in common.

23.62 Databases can also cover the results of the earlier censuses. In developing databases that are aimed at serving a heterogeneous user community, the issue of a number of basic trade-offs will have to be addressed. For example, on the one hand, the number of variables should not be very large to make the database easy to use; on the other hand, it should be as comprehensive as possible to address the broadest possible requirements.

Providing access to micro-data

23.63 In addition to aggregated census results, data users increasingly expect microdata products for advanced analytical use.

23.64 In the context of the agricultural census microdata are the electronic data files consisting of individual records on each unit of observation, i.e. agricultural holding (anonymized for external access). These can be stored in their raw form, in their final edited form, or in a file that combines both raw and edited records. However, normally user's access should be provided to final edited microdata. To limit problems of conservation, the data should be stored on a medium of excellent reliability such as, currently, CD-ROM or DVD-ROM, or universal serial bus (USB) Flash Drive that provides even more storage space. New technologies for mass storage will have evolved. Such new technologies present two issues for census agencies: (a) the issue of when it will be appropriate to adopt a new technology as the standard and (b) that of the need to convert materials stored in older media to the new standard or otherwise provide accessibility to the older materials.

23.65 The organization of the micro-database may take several formats, for example the software may allow for reorganizing the data in a transposed format (for example, one separate file per variable). This can substantially reduce the need for storage space and increase the speed of tabulations. However, establishing this kind of database is more complex, technically demanding and time-consuming. There would be advantages in storing census micro-data with standard commercial databases.

23.66 For the purpose of public dissemination, either online or on electronic media, commonly only a representative sample of the individual records should be made available after ensuring the confidentiality or non-disclosure of individual information. The size of the sample would depend on the capacity and resources of the national statistical/census office.

23.67 Providing access to microdata requires that the institution balance the demands emanating from user community with their legislated requirement and institution's capacities to ensure the security and the confidentiality of the individual information when providing users' access to microdata. Processes aimed at ensuring confidentiality of microdata are referred to Statistical Disclosure Control or anonymisation. The details on provision of microdata to users and considerations to be taken into account by the census agency are provided in Chapter 21, as well as in UN (2015)¹¹⁸.

Country examples on providing access to census microdata (Estonia, Netherlands, Slovakia, Slovenia)- Links

Other products

Geographic products

23.68 Value added products to disseminate census results are represented by cartographic products, either in printed or digital form, such as:

- ◆ Static map (print and web),
- ◆ Census atlas (print and web),
- ◆ Interactive map (web).

23.69 These products are often in high demand from policy makers and the large user community since they provide per example the opportunity to examine spatial patterns of the results of the

¹¹⁸ UN(2015): Handbook on the Management of Population and Housing Censuses (draft, rev.2)

implementation of policies and, on the other hand, identify areas for government to plan further interventions and agribusiness opportunities for the private sector.

23.70 There is an increasing use of maps to show visually the spatial distribution of various characteristics of agriculture. Different data such as average size of holdings, proportion of agricultural land, main crops, irrigated land, livestock, use of paid workers, agricultural practices, etc., can be shown for different political/administrative and geographic areas on a map using different colours or shades. With modern GIS software and equipment, production of such maps and other GIS products is much facilitated

23.71 GIS embody hardware and software configurations designed to support the capture, management, analysis and dissemination of spatially referenced data. Applied to census activities and outputs, such systems facilitate census cartography and data capture, and by linking agricultural holdings' data to geographical areas (and, in some countries with population census and other surveys), GIS provides very powerful data management functionalities in allowing users to explore, analyse, describe and communicate census results according to their information needs.

23.72 GIS provide easy and user-friendly access to census data in user-relevant formats. This allows planners and analysts to undertake monitoring and policy analysis, planning and research that can more readily identify policy and geographic priority areas and thus contribute to evidence-based policy and decision-making at the sub national level. Some of the spatial statistical analysis includes clustering, spatial autocorrelation, outlier analysis, hotspot analysis, ordinary least squares regression, geographically weighted regression, etc.

23.73 The static maps can be part of the report with final results. However, because of the important number of eventual maps, format used, as well as different (more expensive) printing, and different users (implying possibly a different number of copies required) it may be more efficient to publish an atlas separately.

23.74 Most static cartographic products, such as atlases and static maps, can be created using popular geographic information system (GIS) and graphics design software. In addition, interactive web mapping applications allow for construction of interactive maps, such that users can generate maps that focus on various census themes, targeting specific geographies of interest, and allows linkage between maps, tables, graphs and charts for easier interpretation of data. However, they require additional skills and resources that may not be present in the census agency. In that case, the census agency should consider their staff capabilities when requesting products and exploring additional training or contracting out where appropriate.

23.75 As in the case of tabulation of geographic data, there may be limitations in applicability of mapping due to the census data collection methodology, particularly when sampling is used. As data are shown on maps by administrative or other areas there may be a problem in countries with many large holdings spread across several areas, as data for small and other areas may not be representative (see Chapter 6, paragraph 6.57).

Country example (Cambodia) - Links

Brochures and flyers

23.76 Professionally designed brochures and flyers are another way to disseminate basic census data. They should be written in a very easy and comprehensible language and illustrated with suitable

graphics and explanatory material. These products are particularly suitable for preparation as promotional materials for people attending events and exhibitions. As part of the census advocacy, brochures and flyers presenting the key preliminary and final results can be produced and disseminated to stakeholders and key users.

Videos, sketches and on-line videos

23.77 For a better understanding among certain interest groups of census results and in order to promote the use of census data, other dissemination products such as videos, sketches, on-line can be used. These might be useful to show how census data can assist policymakers, planners and people in general to understand better the situation in the agricultural sector and in rural areas and how census data can assist in identifying the main problems and assist with evaluation of solutions.

Country example (Lao PDR) - Links

Methods and tools for dissemination

23.78 A census is not complete until the information collected is made available to potential users in a format suited to their needs. Consequently, meeting the needs of data users means that the census agency should provide to the users not only the data products, but also have them in formats which are suitable to the needs of the users. The information in the products may be included in published tables and reports for general distribution, produced as tables in unpublished form for limited distribution or stored in a database and supplied upon request, or disseminated online either as static or interactive products.¹¹⁹

23.79 Each medium (methods) of dissemination has its advantages and limitations, and the choice of one or more of them depends on the context, and on the intended categories of users. In most instances, these methods complement each other and can provide effective ways to reach out to the public and private sectors. Some considerations regarding choosing dissemination media are discussed below.

Some considerations for choosing dissemination media

23.80 Reports on preliminary and final results, as well as thematic reports can be printed and/or published digitally through the census agency website. The primary concern for that situation is planning for printing costs, since the formatting and layout will usually be the same for both printed and digitally published reports.

23.81 In many countries, some users of census results will not have easy access to computers and will prefer output to be delivered through printed materials. Even in the most advanced countries, many users (for example, community organizations) may wish to receive information in this format. In countries with relatively poor Internet connectivity, users may also prefer to receive information in a computer-readable form via flash drive or similar physical media.

¹¹⁹ *Principles and Recommendations for Population and Housing Censuses, rev. 3, para. 3.267.*

23.82 The challenge for the census agency is to develop products and systems that allow flexibility in output media. For instance, it is possible to develop a standard set of commonly requested tables for each province, district, village or even enumeration area and store these on the census agency's Internet website. Simple applications can be developed that allow the user to specify administrative, statistical or other area that are of user's interest, or a combination of such areas. The census agency can then deliver the tables for the requested areas by direct download. However, IT hardware and software costs for such a digital delivery system should be taken into account when developing the census budget.

Printed materials

23.83 Printed publications remain an important dissemination method of the main census results. Paper media do not require that the user have any particular equipment, software or technical skills. The portability of print media is also a major advantage. However, print media implies printing costs which could be an important part of the census budget.

23.84 It is important that plans be made and sufficient funds be allocated to ensure publication of the tabulations of widespread interest. The choice of how the actual printing is to be done entails a trade-off involving quality of products (especially reliability of data and timeliness), and cost. The best results can usually be obtained by sending the documents in computer readable format to a professional printing company. This will allow high-quality typesetting and the use of supporting colors. Alternatively, master printouts can be made in the census office and sent to the printer for cheaper duplication or offset printing.

23.85 Using tabulation programs to produce output directly for publication allows the traditional method of dissemination of census data through printed reports to be integrated more closely and more inexpensively with the overall institutional statistical production process. Manual retyping of tables once generated should be avoided as much as possible to prevent transcription errors and delays.

23.86 Target publication dates should be determined well in advance and processing and reproduction programmes should be planned accordingly. In addition to traditional methods of printing, there are various methods of reproduction available that are rapid, economical and legible, and these should be investigated.

Online dissemination

23.87 Although a common modality for dissemination of the main results remains printed publications, a wider range of modalities should be applied, enabling users to have access to all published data online and set up valuable service that allows users to access and display census data instantaneously and interactively. That would allow for broader dissemination and a greater range of use of the data. Use of electronic formats encourages greater opportunities for use of the data and further analysis by users, and is therefore encouraged wherever possible.

23.88 The census office website is probably the first dissemination medium where Internet users would look for census information. Online dissemination of data had been common well before the Internet gained prominence. One could use the same website for both internal and broad community communication, with the granting of access rights in certain areas to privileged users only.

23.89 The advantages of online dissemination are found primarily in terms of speed, flexibility and cost and providing accessibility to the results to a wide range of data users. The information is available

to the user as soon as the provider has loaded it on the server and cleared it for access by users. Information can be static or dynamic.

23.90 For reasons of efficiency, it is recommended that information which is provided or likely to be heavily requested by users accessing the census website be made available in a static format, which is faster to download. Letting the user run data extraction on online databases, which would be a dynamic way of accessing the census information, is more resource consuming and should be the additional choice for users to access more detailed data than those available through static pages.

23.91 Advanced interactive web products are growing in popularity. Interactive products allow for complex maps and visualizations, various cross-tabulations, and other customized data queries. These products are designed using a combination of scripting languages that can be broadly divided into two groups depending on where they are executed: server-side (on the census agency server) and client-side (on the user's computer or smartphone). This distinction is important for managers since these tools require computational resources to execute, and therefore affect hardware-purchasing decisions. Some census agencies are delivering data directly from their database to users through an Application Programming Interface (API). APIs have the benefit of providing public access to census data for application developers outside of the census agency.

23.92 Security measures, including passwords, call-back procedures and so on can be used to exclude unauthorized access to data. It is recommended that a powerful firewall constitute a security layer between the website that is visible to the public and the working network of the census office. Internet security, despite being an issue of a technical nature, has to be mandated, demanded and provided resources for by the highest levels of management of the census office.

23.93 Making a census database available online along with integrated searching, tabulating, graphing, mapping and analysis capabilities is an important way to improve the effectiveness of census data dissemination. Interactive web-based data tools should enable users to access census data themselves, and build their own customized tables or spatially configure data outputs according to varying spatial requirements. Many census offices provide user access to electronic databases and data files through their websites, satisfying the full range of needs of internal and external data users. This is a valuable service that allows users to access and display census data instantaneously and interactively.

23.94 In addition to the Internet, interactive electronic products can also be accessed through other media, including CD-Rom, DVD, Flash Drive, etc.

23.95 The methods and tools for safe access to census microdata provided online and offline are discussed in Chapter 21.

Example on census public use databases:

Country examples (Australia, Bhutan¹²⁰, Check Republic, Netherlands, USA, UK) –Links Eurostat: <http://ec.europa.eu/eurostat/data/database>

¹²⁰ Bhutan: Renewable Natural Resources Census 2009- Database User Manual
file:///C:/Users/CaraO/Downloads/Census_Database_Manual.pdf

Other electronic methods

23.96 For an increasing number of users, computer-readable magnetic and optical media are the preferred medium of dissemination. This is because data in this form are often less expensive to obtain, copy and store. In addition, they are directly available for further computer processing and analysis.¹²¹

23.97 Technologies such as flash drives, CD-ROM and DVD-ROM discs provide a medium of distribution for large data sets that are not subject to frequent change or updating. Standard discs are read-only optical media. They have a very large storage capacity, are durable, and can be produced at relatively low cost. Because the results of a census are supposed to be final, dissemination on a read-only medium should be satisfactory.

23.98 Widespread dissemination of census statistics using flash drives or memory sticks may be recommended, per example, for very large volumes of digital content that cannot reasonably be disseminated over the Internet. Further development of media for storing digital data will inevitably have an impact on the dissemination of census results. It is thus necessary to keep abreast with this development in order to meet the changing needs of users of census statistics¹²².

Product launch and promotion of the use of census data

23.99 Census dissemination products and services should be launched in a highly visible manner to ensure maximum public awareness of data availability. The product launch should be widely publicized using all of the promotional activities, including the census agency's website, press releases and social media. The communication/public relations departments generally coordinate this activity. It is a good practice to organise national (which might be followed up by regional) seminars and conferences with the participation of a high-profile government or business personality to ensure maximum media attention.

23.100 Presentations of census results to different segments of users, such as academia, central and local governments, farm associations, businesses and media are also important to promote the use of census results. If relevant, a demonstration can be made on how to access and retrieve data and documentation on the census on the agency website. In other cases, users may be willing to use the information but require additional training to more fully understand the data. Such training may be usefully combined with training in statistical dissemination techniques and/or uses of more advanced data products.

References and suggested reading:

Eurostat (2014). ESS handbook for quality reports,
<http://ec.europa.eu/eurostat/documents/3859598/6651706/KS-GQ-15-003-EN-N.pdf>)

Eurostat. Census National Methodology Reports 2010,
<http://ec.europa.eu/eurostat/web/agriculture/national-methodology-reports>

¹²¹ Principles and Recommendations for Population and Housing Censuses, rev. 3, para. 3.275.

¹²² UN (2015). Handbook on the Management of Population and Housing Censuses (draft, rev.2), para 6.197

Global Strategy (2014) Providing Access to Agriculture Microdata <http://www.gsars.org/providing-access-to-agriculture-microdata-a-guide/>

U N (2015). Principles and Recommendations for Population and Housing, Censuses rev 3: the 2020 Round, http://unstats.un.org/unsd/demographic/meetings/egm/NewYork/2014/P&R_Revision3.pdf

UN (2015). Handbook on the Management of Population and Housing Censuses (draft, rev.2).

DRAFT

CHAPTER 24 RECONCILIATION OF CURRENT STATISTICS WITH CENSUS RESULTS

Reconciliation of Census and Surveys data

24.1 The existence of discrepancies between the census results and the previous published estimates from agricultural surveys performed during the intercensal period is a common issue in many countries. Important gaps may be observed when comparing indicators like crops area and production, agricultural population or quantity of fertilisers collected during the census with the estimations from the previous year survey. These gaps may be originating from various sources and a number of solutions exist to address them. That is the purpose of the reconciliation of census and surveys data, which consists basically in comparing the estimates from previous surveys and the census results regarding a number of important agricultural indicators and correcting the discrepancies between them. In some developed countries like USA and Canada, Data reconciliation process is institutionalized and systematically performed after censuses.

24.2 The main objective of the reconciliation is to improve the estimates of surveys data (experts estimates) using the census data and to draw lessons for future surveys. However, reconciliation may also help to correct some census data considering the estimates from surveys (experts estimates).

24.3 Bernhardt and Helfand (1980) specifies the following main objectives of the reconciliation of Economic Censuses and surveys data by the U.S. Bureau of the Census:

- ◆ To measure the extent of differences between the censuses and current surveys in coverage, classification, and data;
- ◆ To determine why the differences occurred;
- ◆ To identify systematic errors, make corrections during census and survey processing, and take steps to minimize similar future errors;
- ◆ To identify random errors, including reporting errors, and make corrections, thus improving the annual and census estimates;
- ◆ To improve coverage in survey through the addition of new units;
- ◆ To improve the quality of the annual and census levels used for benchmarking current survey estimates;
- ◆ To serve as a guide in planning for future surveys and censuses.

Common sources of discrepancies between Census and Surveys data

24.4 Some gaps between surveys estimates and census data may be normal due to many factors including changes due to difference in the implementation time. However, other gaps may arise from both sampling and non-sampling errors. The identification and the correction of these later gaps is the main purpose of data reconciliation.

24.5 The Global Strategy to Improve Agricultural and Rural Statistics has conducted a research and is developing a methodological guidelines on reconciliation of census data with survey data¹²³. This section provides an overview of the findings and recommendations contained in the GS guidelines. The,

¹²³ The published deliverables of this line of research implemented by FAORAF are available here: <http://gsars.org/en/tag/dataanalysis/>

common sources of gaps are discussed and possible solutions for correcting the discrepancies between census data and survey data are reviewed taking into account relevant countries experience.

Sampling errors

24.6 Lohr (1999) defines sampling error as the error that results from taking one sample instead of examining the whole population. Sampling bias or error is inevitable (Fink, 1995). The level of the sampling errors can be significantly high because of a number of factors including: insufficient sample size, non rigorous random sampling, inadequate sampling design or use of clusters with low intra variability. In this case, sampling errors can cause discrepancies between census and surveys data.

Non sampling errors

24.7 Non-sampling errors can be defined as errors in sample estimates which cannot be attributed to sampling fluctuations. Unlike sampling errors, they can be present in both sample surveys and censuses.

24.8 From Biemer and Lyberg (2003) and Banda (2003), mainly six types of non sampling errors can be considered: specification, frame, non-response, measurement, processing and estimation errors. Some of them, experimented by countries as source of discrepancies, are discussed below.

Specification error

24.9 This occurs when the concept implied by the question is different from the underlying construct that should be measured.

24.10 The difference in variable specification between survey and census may cause discrepancies in data. In fact, changes in concepts and definitions may affect estimates. To avoid such issues, the Global Strategy promotes an integrated agricultural statistics system with harmonized concepts and definitions between agricultural censuses, other censuses (such as population censuses) and agricultural statistical surveys.

Coverage or frame error

24.11 Kish (1995) provides four basic frame problems: missing elements, clusters of elements, blanks or foreign elements and duplication. Among them, missing elements and foreign elements described below are considered in the literature are basic causes of discrepancies. The likelihood of these problems in a frame is particularly high when the frame is not updated.

(i). Missing elements (non-coverage or incomplete frame)

24.12 Non-coverage denotes failure to include some units of the defined survey population in the sampling frame. It is different from non-response which is due to an unsuccessful attempt to collect survey data from a sampled eligible unit, a unit in the target population.

24.13 Non-coverage is a common issue in every census. Especially for agricultural census, due to the complexity of the agriculture sector, it is difficult to cover all the holdings even for developed countries. In Brazil, during the 2006 agricultural census, it was found that 11 per cent of holdings had ceased to provide information on production. Thanks to other sources like supply/utilization balance, it is found that underestimation of the production is in the order of 13.6 per cent for soybeans, 17.2 per cent for sugar cane, and 42.9 per cent for orange (Global Strategy, 2016; Guedes & Oliveira, 2013).

24.14 Non-coverage is particularly a serious concern when the census frame is used for annual surveys during the intercensal period given that a large number of new units may appear in the population after the census. This is being experimented by the NASS of the USA: In 2016, for the local foods survey, list frame obtained by means of web scraping has been used (Global Strategy, 2016). Countries using panel samples during the intercensal period may undergo this problem at a large extent.

(ii). Blanks or Foreign elements

24.15 In this case, some units non-members of the defined survey population are included in the frame. This issue, also called misclassification in Global Strategy (2016), is often a source of discrepancy between census and survey data. For instance, a holding which meets the definition of an agricultural holding may be incorrectly classified as a non-agricultural holding, or a non-agricultural holding arrangement is incorrectly classified as an agricultural holding.

Non-response

24.16 Nonresponse refers to the failure to obtain observations on some units selected for the sample. If not addressed properly, they can cause important biases in estimations.

24.17 Every estimation method involves an estimation bias, arising from the simple fact that the quantity to be estimated generally differs from its estimator. Estimation errors include also errors of coverage, sample selection and implementation, non-response, as well as sampling variability. This group of errors centres on the process of sample design, implementation and estimation.

24.18 When the surveys are conducted with a panel of agricultural holdings selected from the data of the most recent general agricultural census, the discrepancies between census and survey data could be ascribed to the disappearance, division, or merger of holdings over time due to endogenous or exogenous events. Phenomena occurring in the population may also impair sample quality. These changes adversely affect panel quality because they directly influence sample size and the weight of the statistical units (Global Strategy, 2015).

Correcting discrepancies

24.19 Mainly four (04) operational steps may be considered when performing data reconciliation.

Selecting the key variables for reconciliation

24.20 Data reconciliation may be a time consuming task especially when advanced techniques are required to correct the gaps. In fact these techniques required sometimes the collection of secondary data for their implementation. Accordingly, rigorous data reconciliation may not be possible for all the survey variables. It is therefore important to identify a number of key variables for the reconciliation process.

Computing the gaps

24.21 The second step is to calculate the gap between surveys and the census data regarding the key variables selected. Both absolute and relative growth needs to be made available for the next step. Comparisons of ratios (e.g. proportion of maize planted area) may also be helpful given that ratios are not likely to change in a short term.

Making the diagnosis

24.22 For each variable, it is important to analyse if the gap is normal or if there is a discrepancy. As stated above, some gaps may be linked to the normal evolution of variables from the year of the survey to the one of the census. In some cases, previous conjectural factors occurred in the country may explain the differences in data. In this step the opinions of experts with deepen knowledge of the agricultural economy of the country may be helpful. Secondary data may also help to understand some gaps.

24.23 When discrepancies are identified, their sources should be explored in order to assess the causes of the gaps.

Corrections

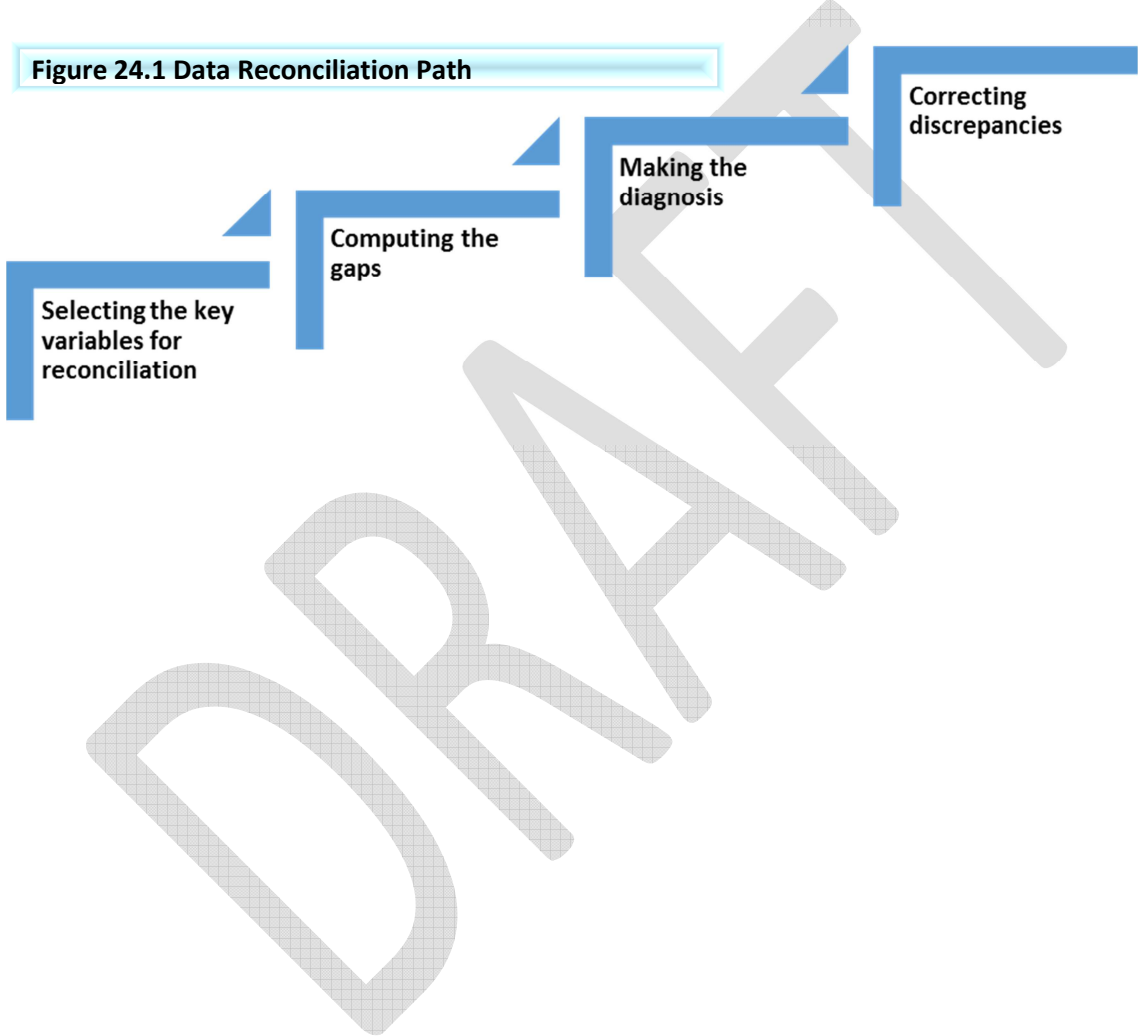
24.24 After the diagnosis, the last step is the correction of discrepancies. Regarding the sources identified, the suitable methods to correct discrepancies should be considered. Global Strategy (2016) discusses some methods used in the literature for data reconciliation. Table 24.1 summarises these techniques for some causes of discrepancies.

24.25 The data reconciliation is an important exercise but cannot be systematically perform by all the countries due to the difficulty to justify the review of past figures already used by policy makers. But methods and techniques to perform data reconciliation after each census occurrence need to be made available and countries are encouraged to undertake the exercise. In the planning phase of the census, budget and expertise must be dedicated to this exercise.

Table 24.1 Methods used for data reconciliation

Sources of gaps	Methods	Brief description
Misclassification of units in strata	Post stratification	Post-stratification helps to adjust the survey sample data to make it more consistent with the population's structural parameters based upon the census data
Some holdings were overrepresented in the sample	Ad hoc trimming method	The ad hoc method establishes an upper cut-off point for large weights, reducing weights larger than the cut-off weight to the cut-off value and then redistributing the weight in excess of the cut-off to the non-trimmed cases. This ensures that the weights before and after trimming add up to the same totals.
Estimation errors due to ageing of sample weights : sample weights correction (1)	<ul style="list-style-type: none"> • Best Linear Unbiased Prediction (BLUP) method • Robust BLUP Method • Difference estimator method 	Basically, these Model-based methods allow to re-estimate the survey data through new survey weights calculated using a model to estimate the values of a target variable for unobserved units using the census data and auxiliary variables
Estimation errors due to ageing of sample weights : sample weights correction (2)	Growth rate method	This method calculates growth rate using only censuses data. The growth rate is used to adjust the sampling weights. The new estimates are inflated or deflated according to this growth rate.
Errors in weights	<ul style="list-style-type: none"> • Cross-entropy estimation method • Generalized Regression (GREG) method 	This method proposes adjustments of the sample weights using the new censuses data or other new and accurate estimation. It makes the sample resemble the new population, but at the same time maintains the adjusted weights as similar to the original weights

Sources of gaps	Methods	Brief description
	<ul style="list-style-type: none"> Spline method (Robust GREG) 	as possible.
Misclassification of members and non-members of the population	Capture-recapture approach	This method is applied when Census and Survey are performed in the same reference period. It estimates the probability that a “survey farm” is captured by the Census and it is used to adjust the original survey weights.



Box 24.1 Case study: Data Reconciliation by Statistics Canada

Data Reconciliation of Survey and Census data is an institutionalised process in Canada. At the one hand, survey data are considered during the validation process of Census data and at the other hand survey data are revised using census data.

(i). Census Data Validation process

The main objectives of Data Validation are to guarantee the quality and consistency of the Census of Agriculture data and to make recommendations for their publication before being released to the Canadian public. Data validation is a complex process in which human judgement is vital. In broad terms, the process starts at the more general, macro level (i.e., provincial overviews), flows toward the more specific, micro level (i.e., individual census questionnaires) and then ends with a final macro-level review.

During the census microdata validation process, individuals' suspicious data may be compared to previous surveys data of the same individuals in case they had been sampled.

(ii). Intercensal revision of surveys data

Intercensal revisions to agricultural commodities are usually completed one to two years after the Census data are released. The survey estimates are revised to match as closely as possible to the Census numbers adjusted for seasonal variation, when appropriate. The revisions made on commodities can be summarized by being either a wedge adjustment or a logarithmic adjustment depending on the characteristics of the data and commodity. Only the trend is adjusted not the magnitude of the change year to year.

Comparison of variables such as area (and in some cases expenses) is first done between surveys and the Census of agriculture to determine the extent of the frame change and the potential intercensal adjustments.

Ratios are used in different ways for any commodity to support the analysis: (a) The ratio of published numbers to Census numbers; (b) The ratio of Census numbers compared to survey level estimates; (c) ratio of average yield (from the survey) on the total area (from the Census) to adjust production; (d) The Census inventory data adjusted for seasonal variation (for cattle and sheep); etc.

Certification: Revised survey estimates are verified by other members of the team. Provincial experts are also consulted to have their viewpoints on the possible extent of revision.

Communication plan: A communication plan is put in place to inform all key users that new intercensal revisions have been made available. Typically users know that estimates are revised every 5 years.

References and suggested reading

- Banda, J.P. 2003. Non sampling errors in surveys. United Nations Secretariat ESA/STAT/AC.93/7 Statistics Division
- Bernhardt and Sol D. Helfand. 1980. Reconciliation of the Economic Censuses Results and Current Surveys Program, 1980 Annual American Statistical Association Meeting
- Biemer, P.P., and others , eds. (1991). Measurement Errors in Surveys. New York: John Wiley and Sons.
- Biemer, P.P. and Lyberg, L. E. (2003). Introduction to Survey Quality. Wiley Series in Survey Methodology, Wiley, Hoboken.
- Cochran, William G. 1953. Sampling Techniques. New York: John Wiley & Sons, Inc.
- Fink, Arlene. 1995. How to Sample in Surveys. Vol. 6. London: Sage Publications
- Global Strategy to improve Agricultural and Rural Statistics. 2015. Handbook on Master Sampling Frames for Agricultural Statistics. Global Strategy Publication, Rome.

Global Strategy to improve Agricultural and Rural Statistics. 2016. Literature Review on Reconciling Data from Agricultural Censuses and Surveys. Global Strategy Publication, Rome.

Guedes, C.A.B. & Oliveira, O.C. 2013. The importance of system GCEA to Brazilian agricultural statistics. Paper prepared for the International Conference on Agricultural Statistics VI (IDCB Technical Session 7), 23-25 October 2013. Rio de Janeiro, Brazil.

<http://eventos.ibge.gov.br/images/icas2013/resumosposter/IDCB-OliveiraGuedes.pdf> accessed on 26/08/2016

Kasprzyk D (2005) Measurement error in household surveys: sources and measurement. Mathematica Policy Research. In: Household Sample Surveys in Developing and Transition Countries, Department of Economic and Social Affairs (editors), Washington, DC: United Nations Publications, pp 171–198

Kish, L. 1995. Survey Sampling. Wiley, New York, NY

Lohr, Sharon L. 1999. Sampling: Design and Analysis. Albany: Duxbury Press

Statistics Canada. 2011. Statistics: Power from Data! Web resource:

<http://www.statcan.gc.ca/edu/power-pouvoir/toc-tdm/5214718-eng.htm> accessed on 23/8/2016

DRAFT