

FAO STATISTICAL DEVELOPMENT SERIES

6

Conducting agricultural censuses and surveys



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FOREWORD

Since its establishment, FAO has promoted national censuses of agriculture through the 1950, 1960, 1970, 1980 and 1990 Programmes for the World Census of Agriculture.

In October 1995, FAO published the Programme for the World Census of Agriculture 2000 to assist countries with the conduct of their agricultural censuses, in the decade 1996-2005, by providing definitions, concepts, standards and guidelines for this Programme.

This publication 'Conducting Agricultural Censuses and Surveys' is a revised and updated edition of 'Taking Agricultural Censuses', 1978, FAO. It is complementary to the Programme for the World Census of Agriculture 2000 and provides much practical information on the steps involved in actually conducting an agricultural census either on a complete enumeration basis or a sample basis.

The revisions made refer particularly to new technical advances in computer techniques, frame preparations, sampling, etc. The principles for 'getting the job done' are based on many years of on-the-job experience contributed by national and international experts in this field as well as the staff of FAO's Statistical Development Service. FAO is grateful to all who have provided inputs and hopes member countries will find it facilitates and contributes to their conduct of national agricultural censuses so as to advance their qualified knowledge of the agricultural sector.

The Director
Statistics Division

CHAPTER 10. CENSUS PUBLICITY

Organization of publicity campaign	10.1-10.7
Types of media	10.8-10.9
Timing, duration and frequency of campaign	10.10-10.11
Other possible action to obtain support and cooperation of holders	10.12
Examples of media	10.13-10.18

CHAPTER 11. INSTRUCTION MANUALS

Purpose of the instruction manuals	11.1-11.2
Timely preparation of manuals	11.3
Authors of the instruction manuals	11.4-11.5
Presentation of the instruction manuals	11.6
Format of the instruction manuals	11.7-11.11
Contents of the instruction manuals	11.12-11.15
Manual for the enumerator	11.16-11.18
Manual for the supervisor	11.19-11.26
Training of enumerators	11.27-11.29
Intensity of supervision	11.30-11.32
Authority of the supervisors	11.33
How to solve the difficulties of the enumerators	11.34-11.38
Manual for the provincial coordinators	11.39-11.44

CHAPTER 12. TRAINING PROGRAMME

Introduction	12.1-12.6
Training at international centres	12.7-12.10
Training at national centres	12.11-12.12
Duration and content of enumerator training courses	12.13-12.17
Duration and content of supervisor training courses	12.18-12.19
Use of training aids	12.20-12.25
Training in writing inspection reports	12.26-12.27

CHAPTER 13. PRE-TEST SURVEYS AND PILOT CENSUSES

Introduction	13.1-13.2
Pre-test surveys	13.3-13.4
The pilot census	13.5-13.7
Concepts and definitions	13.8
Estimating resource requirements	13.9-13.11
Frame	13.12-13.13
Questionnaire	13.14-13.18
Training of enumerators and supervisors	13.19
Methods of data collection	13.20-13.24
Sampling design and sample size	13.25-13.27
Data processing	13.28-13.31

CHAPTER 14. CENSUS ENUMERATION

Introduction	14.1-14.3
Time reference	14.4-14.5
Duration and period of enumeration	14.6-14.12
Control of census operations and time schedule	14.13-14.15
Methods of enumeration	14.16-14.27
Some tips on interviewing	14.28-14.37
Special problems of census enumeration	14.38-14.59

Advantages of carrying out a census on the basis of complete enumeration	6.10-6.14
Disadvantages of carrying out a census on the basis of complete enumeration	6.15-6.17
Factors for consideration in choosing between a complete or a sample census	6.18-6.21
Main types of sample designs for agricultural censuses	6.22
List sample designs	6.23-6.25
Data collection procedures for list sample designs	6.26
Area sample designs	6.27-6.29
Data collection procedures for area sample designs	6.30-6.32
Estimation procedures in area sample designs with segments that have recognizable physical boundaries	6.33-6.36
The weighted segment estimation method	6.37-6.38
The open segment estimation method	6.39-6.40
Multiple frame sample designs	6.41-6.44
Choice of sample design	6.45-6.49
Multiple frame designs versus area sample designs	6.50
Multiple frame designs versus list sample designs	6.51-6.52
Other uses of sampling techniques	6.53-6.54

CHAPTER 7. PREPARATION OF THE FRAMES

Definition of frame	7.1-7.4
Practical approaches of frames	7.5-7.8
The frame of a census conducted by complete enumeration	7.9-7.20
Construction of the frame using the population and housing census	7.21-7.35
The frame of a census conducted by sample enumeration	7.36
Preparation of the frames for list sample designs	7.37-7.48
Preparation of the frames for area sample designs	7.49-7.50
Preparation of the frames for area sample designs with segments that have recognizable physical boundaries	7.51-7.57
Preparation of the frames for area sample designs with segments that coincide with the land of agricultural holdings	7.58
Preparation of the frames for multiple frame sample designs	7.59-7.61
Geographic Information Systems	7.62

CHAPTER 8. CENSUS QUESTIONNAIRE

Development of the census questionnaire	8.1-8.20
Census questionnaire working group	8.21-8.24
Use of questionnaires developed in other countries	8.25
Tabulation plan	8.26
Processing the questionnaire	8.27-8.37
Testing of census questionnaires	8.38

CHAPTER 9. TABULATION PLAN

Introduction	9.1-9.5
Talk to the users	9.6-9.7
Data processing and evaluation	9.8
Amount of tabulation for administrative units and the limitations due to sampling	9.9-9.12
Preparation of the tabulation plan	9.13-9.21
Cross-tabulations	9.22-9.34
Presentation of the tabulation plan	9.35-9.39

CONTENTS

FOREWORD	Page iii
INTRODUCTION	Pages viii-xi
CHAPTER 1. CENSUS LEGISLATION	<u>Paragraphs</u>
Introduction	1.1-1.3
Main features of census legislation	1.4
Juridical basis of agricultural census legislation	1.5
Authority for the promulgation and execution of legislation	1.6-1.7
Scope of census legislation	1.8-1.10
Contact with the respondent and obligatory collaboration	1.11-1.14
Confidentiality of information and penalties	1.15-1.16
Annex: Example of law (Canada)	1.17
CHAPTER 2. CENSUS COMMITTEE	
Composition of the committee	2.1-2.2
Main responsibilities and functions	2.3
Establishment of sub-committees and working groups	2.4
Establishment of provincial committees	2.5
Other boards/committees	2.6
CHAPTER 3. WORK PLAN, BUDGET AND EXPENDITURE CONTROL	
The work plan	3.1-3.5
The financial outline	3.6-3.9
Preparation of the budget	3.10-3.12
Review of the work plan, the budget and frequency	3.13-3.20
CHAPTER 4. CENSUS STAFF	
Introduction	4.1-4.2
Census coordinator	4.3
Members of the census office	4.4-4.8
Field staff	4.9-4.10
Enumerators	4.11-4.15
Supervisors	4.16-4.20
Organizational aspects	4.21-4.23
CHAPTER 5. CARTOGRAPHIC PREPARATION	
Introduction	5.1-5.7
Purpose of maps	5.8
Exploration of existing map resources inventory	5.9
Types of maps used	5.10
Timing of cartographic preparation	5.11-5.13
Computer-assisted cartography	5.14
CHAPTER 6. THE SURVEY DESIGN	
Objectives of agricultural censuses and surveys	6.1-6.4
Sample design and survey design	6.5-6.8
Complete enumeration censuses versus censuses carried out on a sample basis	6.9

Supervision of field work	14.60
Procedure for collecting and forwarding completed questionnaires	14.61
 CHAPTER 15. ORGANIZATION OF FIELD WORK	
Department responsible	15.1-15.3
Provincial offices and their work	15.4-15.8
Census field staff	15.9-15.11
General organization of field staff	15.12-15.17
Supervisory work and staff	15.18-15.22
Enumeration work and staff	15.23-15.26
General suggestions for preparing the interview	15.27-15.29
 CHAPTER 16. QUALITY CHECKS AND POST-ENUMERATION SURVEYS	
Introduction	16.1-16.4
Sources of non-sampling errors	16.5-16.20
Checking census tables against other data	16.21-16.23
Supervision and post-enumeration check	16.24
Purpose of the post-enumeration survey	16.25-16.29
Design of the post-enumeration survey	16.30
Method of data collection in the post-enumeration survey	16.31-16.32
Presentation of errors detected in the post-enumeration survey	16.33-16.40
 CHAPTER 17. DATA PROCESSING	
Prior experiences	17.1-17.4
Hardware	17.5-17.11
Software	17.12-17.19
Purpose of checking, editing and coding data	17.20-17.24
Data processing activities	17.25-17.27
Monitoring and control of questionnaires	17.28-17.29
Checking (manual editing) and coding	17.30-17.36
Data entry and verification	17.37-17.41
Data entry alternatives	17.42-17.43
Computer editing and coding	17.44-17.49
Imputation	17.50-17.53
Storage and security	17.54-17.55
Tabulation	17.56
Calculation of sampling errors and other analysis	17.57-17.58
Testing computer programmes	17.59-17.60
 CHAPTER 18. DISSEMINATION PROGRAMME	
Introduction	18.1-18.3
Informing the users	18.4-18.7
The publication plan	18.8-18.9
Preliminary results (report)	18.10-18.16
Final report	18.17-18.22
Atlas	18.23-18.24
Technical report	18.25-18.27
Report on quality checks and post-enumeration surveys	18.28-18.29
Other kinds of dissemination	18.30
 GLOSSARY	 Pages 159-162

INTRODUCTION

This publication is intended for national statisticians who are responsible for conducting an agricultural census or survey. Within the census organization there will be many specialists involved in particular aspects of the census. For these specialist, 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. It may also be of interest to the government officials involved in deciding if and when to organize an agricultural census, particularly for those who have limited experience of such a major statistical exercise.

Special endeavours have been made to make the document 'user-friendly' by:

- adding a summary at the beginning of each chapter to help the reader select those subjects of specific interest;
- adding specific references at the end of most chapters, providing further information on specialized fields, and;
- the insertion of a glossary of the main terms used in the document.

In different countries the agricultural census may be organized in various ways depending upon the resources available, the importance of agriculture and the tradition in census organization. An agricultural census should be part of an integrated system of agricultural statistics with the objective of providing primary data on the structure of the agricultural sector, such as size of holdings, land use, land tenure, etc., which do not change quickly over time. Detailed data on agricultural production and inputs are part of the system of agricultural statistics, called current statistics, and are collected through specialized agricultural surveys and other sources.

It is recognised that many countries do not have sufficient resources for conducting a series of surveys and collect the most important data through a single survey called an agricultural census. It is also important to note that, by 1960, collecting census data on a sample basis had become an accepted practice and made possible the organization and conduct of censuses in countries lacking the resources required for a complete enumeration. Therefore, there is now no clear distinction between agricultural censuses conducted on a complete enumeration basis and those conducted on a sample basis. Because of this, the title "Conducting Agricultural Censuses and Surveys" was given to this publication.

The Programme for the World Census of Agriculture 2000 is the eighth publication for promoting a global approach to agricultural census taking. The first action towards a World Census of Agriculture was initiated by the International Institute of Agriculture (IIA) in Rome in 1924, which made an effort to persuade member countries to provide data based on a uniform plan prepared by the Institute. The main objective was to obtain internationally-comparable data for 1930 through the enumeration of crop and livestock production in one operation.

Since then, every ten years there has been international action to promote World Censuses of Agriculture, first by IIA (for the 1930 and 1940 censuses) and then by FAO. Concepts, definitions and methodology of census taking evolved and became more uniform with the scope increasingly focused on the structural aspects of the agricultural sector. FAO Statistics Division had a major role in promoting the use of sampling in agricultural statistics in general and in the agricultural census in particular. This has been done through

methodological publications, technical assistance and training activities. The agricultural holding became a standard unit of enumeration. The emphasis in international action shifted from the objective to collect internationally comparable data to assisting countries to meet more closely their national objectives for the census.

Once the decision to conduct an agricultural census is taken, many different activities have to be planned. These activities are described in the present document in eighteen different chapters, which are presented in chronological order, to the extent possible.

One of the first steps to be undertaken is to ensure that the legal basis for the census organization exists. This is the subject of Chapter 1 "Census legislation". Related activities may be very different from country to country, ranging from simply ensuring that satisfactory legislation exists, as in some countries even the obligation to organize a census is governed by law, to the situation where the preparation of complete legislation is necessary in order to designate the responsible office for census taking, usually the Central Statistical Office or the Ministry of Agriculture, and to ensure the required budget.

The next step is the establishment of the census organization. This includes establishment of an inter-ministerial steering committee, described in Chapter 2 "Census committee", deciding on a detailed plan of action, described in Chapter 3 "Work plan, budget and expenditure control" and planning the staff recruitment, in Chapter 4 "Census staff".

It is essential to start early preparations of the cartographic material and the census frame, which are required for the organization of the field enumeration as described in Chapter 5 "Cartographic preparations" and Chapter 6 "Preparation of frame". Closely related to these issues is the question whether the census could be organized on a sample basis, instead of, or in addition (for a part of the data) to, a complete enumeration. This is discussed in Chapter 7 "Use of sampling techniques".

Basic census documents are the questionnaire, which specifies the exact data to be collected, and the tabulation plan, which must be in line with the questionnaire and prepared simultaneously with it. These two subjects are covered in detail in Chapter 8 "Census questionnaire" and Chapter 9 "Tabulation plan". These two documents are crucial for the whole census organization: the questionnaire for the organization of field work and the tabulation plan for defining data processing activities and for planning a dissemination programme.

Final preparations for the conduct of the census are described in Chapters 10 to 13. An effort should be made to encourage holders to cooperate in providing data, this is done through a publicity campaign which is described in Chapter 10 "Census publicity". One of the major census activities is training the enumerators and supervisors, which is normally done just before the census. For this purpose, detailed manuals are required which will also be used as reference material during the enumeration. The relevant information on these topics is provided in Chapter 11 "Instruction manuals", and Chapter 12 "Training programme". It should be kept in mind that the training of technical staff, such as training of trainers, data processing and sampling specialists, etc., has to be organized very early, so that these staff are available to work on the census preparations. All preparatory work described in Chapters 5 to 10, as well as preparations for data processing, will have to be tested extensively in the field prior to embarking on the enumeration. Methods of testing are described in Chapter 13 "Pre-test surveys and pilot censuses".

The most important census activity is the field enumeration. This involves many topics including decisions on methods of enumeration and organization of the supervision. These topics are covered in Chapter 14 "Census enumeration" and Chapter 15

"Organization of field work". It is important to have an independent evaluation of the data collected, before they are made available to users. Methods of data evaluation are described in Chapter 16 "Quality checks and post-enumeration surveys".

The activities after the enumeration include processing the data collected, which is described in Chapter 17 "Data processing". It should be kept in mind that although the actual processing is undertaken after the enumeration, the technical part, i.e. preparation and testing of the computer programs and procedures, must be completed before data start arriving from the field. The presentation to the public of the final product of the census operation, i.e., the census results, is described in Chapter 18 "Dissemination programme".

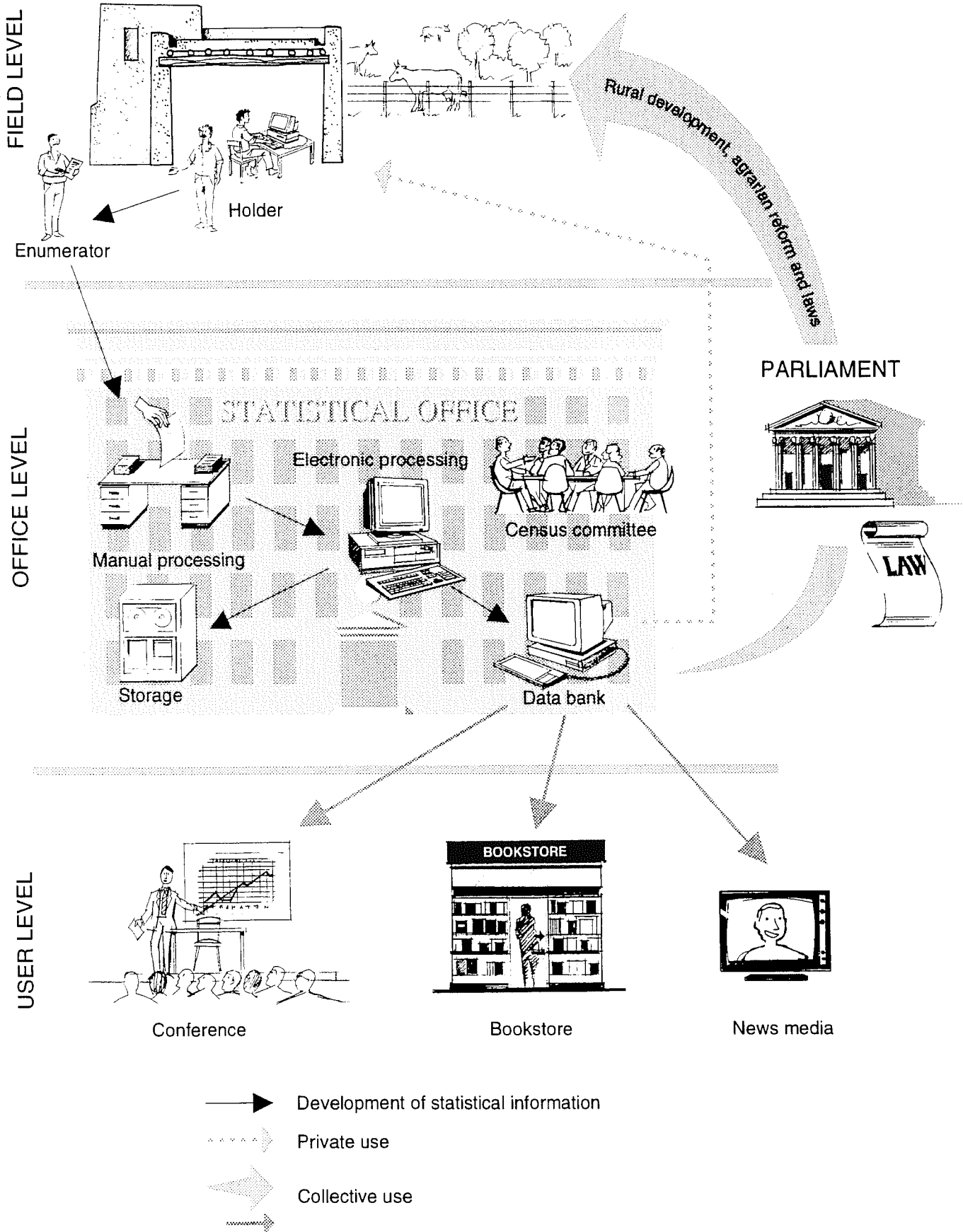
The following sketch (see next page) gives an overview of an agricultural census, involving first the holders for the collection of primary information, which is basically aimed at providing statistical data required for development planning and for constructing frames for other surveys, and also increasingly for individual uses, in private monitoring of agriculture for example. The organization of an agricultural census involves many different resources: personnel of different specializations, equipment for transport and data processing, and various expendable materials, as well as long preparations including cartographic preparations, development of manuals, pilot censuses, etc. Such an operation cannot be done quickly and may take from three to six years from the initial planning to delivery of the final results, depending upon the size of the country, existing resources and experience.

This publication is complementary to other FAO publications which are listed below, and which include reports and examples of census methodology as applied in different countries, proposed census items and their definitions, and the role of the agricultural census in the national system of food and agricultural statistics.

Suggested reading

- FAO (1977). Report on the 1970 World Census of Agriculture, FAO Statistics series no. 10.
- FAO (1986). Food and agricultural statistics in the context of a national information system.
- FAO (1992). 1980 World Census of Agriculture: Methodological review.
- FAO (1995). Programme for the World Census of Agriculture 2000

THE LOOPS OF STATISTICAL INFORMATION



An Agricultural Census is a large-scale, periodic, statistical operation for the collection of quantitative information on the structure of Agriculture.

The word "census" implies a complete enumeration of all agricultural holdings. However, by extension, it can be conducted by a sample enumeration, provided the sample is large enough to generate sub-national data.

CHAPTER 1

CENSUS LEGISLATION

The importance of an agricultural census for both the national economy and individual users is such that many countries have introduced legislative measures to support the development of their agricultural statistics, in general, and the agricultural census in particular.

The agricultural census legislation is, in most countries, an integral part of legislation on statistics in general. It covers administrative matters such as designating the office responsible for the organization, and financial matters concerning the budgetary arrangements. In many countries the frequency and scope of the census are also covered. Perhaps the most important part of the legislation refers to obligations to respect the confidentiality of the respondent data, and obligations of respondents to provide data to the best of their knowledge. In both cases sanctions may be envisaged.

The purpose of this chapter is to present only a broad approach to the subject and give some ideas to the responsible national officers regarding the improvement or introduction of national legislation in taking an agricultural census. Those who have more interest in the matter may refer to the FAO Legislative Study no. 32 "Agricultural census legislation" (1984).

In the annex to this chapter an extract of the Statistics Act of Canada is shown as an example of legislation on statistics.

Introduction

1.1 The General Assembly of the International Institute of Agriculture at Rome, at its biennial meeting in May 1924, authorized the Institute to proceed to promote the taking of an agricultural census in 1930-31 in all countries. Since then, governments have recognized the need for a legislative basis for conducting their own agricultural census. Decennial (the now customary frequency) censuses entail major commitments of resources, and it is essential that legislative provision be made for their preparation and implementation.

1.2 Census legislation, or the collection of laws governing census activities, is one of the first aspects to be considered when starting to plan the census, since it constitutes one of the most important instruments for facilitating the census work. This can be a law of a general nature granting a specific agency in the government the authority to gather wide-ranging information. Usually, such a law would either be a provision in the constitution of the country or specific legislation creating a statistical agency and specifying its broad statistical functions.

1.3 Legislation should normally deal with the following:

- 1.3.1 **Scope and coverage.** The 40 national texts on census legislation examined indicate that the agricultural census covers a broad range of subjects. The scope of the agricultural census should be described in general terms in the Principal Act, 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 items of information pertinent to the

time the census is taken. It should be specified 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 communications. Exclusion may be complete or certain census operations postponed until a later date.

- 1.3.2 **Frequency of the census and time reference.** The rapid changes occurring in the agricultural sector have to be taken into account in determining the frequency of the agricultural census. In some countries where the ten-year interval is too long because of these rapid changes, quinquennial or more frequent censuses are needed. The frequency is usually determined in the Principal Act. Such an enactment would establish the legislative or budgetary authority for the census to be taken at regular intervals and for the provision of the necessary funds. The permanent census organization can therefore plan 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 Act will not be mandatory where budgetary funding cannot be found. In any case, the frequency indicated is intended to provide a general guideline. 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 subjects of enquiry.
- 1.3.3 **Responsibility for the census.** The primary administrative body responsible for the census should be indicated in the Principal Act. Subsidiary legislation, however, may call upon other government agencies 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 subsidiary legislation that the operation is in accordance with the plans drawn up by the primary administrative body in order to prevent cooperating agencies or local governments from independently introducing innovations for their own purposes, which could disrupt the timetable of operations.
- 1.3.4 **Administrative and financial provisions.** The Principal Act should grant the census agency full executive authority over the administrative 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 Act should also vest full authority over the budget in the census agency. Usually, the funds for a census are allocated in the relevant section of the national budget, in an amount recommended by the census agency. The ideal census budget assigns the agency authority to reallocate resources when unforeseen difficulties arise, especially during the final stages. When other agencies are called upon to participate in the census operation, the relevant enactment may also indicate whether or not their expenses are to be borne by the respective agencies themselves.
- 1.3.5 **Obligations of the public with respect to the census.** The obligation of the public to cooperate in the census operations is normally provided for in the Principal Act, and will very likely be reiterated and treated in detail (including the provision of penalties for non-cooperation) in subsidiary legislation. Refusal to be interviewed or to furnish the data needed, or giving false information or delaying the submission of returns, can be punishable acts. Holders often tend to be sceptical of statistics and the usefulness of the

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

- 1.3.6 **Identification, protection and obligations of enumerators.** The identification, protection and obligations of enumerators can be additional matters for which the legislation may prescribe. Proper identification papers for the enumerators are essential to ensure the confidentiality of the information and the obligation of the respondent to cooperate. As a matter of policy, identification papers 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. Setting down their specific obligations in the subsidiary law can make the enumerators better aware of their functions and make it less likely that they will abuse or neglect them.

Main features of census legislation

1.4 In the following sections, a description is given of some of the major aspects of national laws/decrees of several countries that participated in the 1970, 1980 and 1990 censuses. The following five topics were selected as a basis for their presentation:

- (i) Juridical basis of agricultural census legislation.
- (ii) Authority for the promulgation and execution of legislation.
- (iii) Scope of census legislation.
- (iv) Contact with the respondent and obligatory collaboration.
- (v) Confidentiality of information and penalties.

Juridical basis of agricultural census legislation

1.5 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 in its statutes and any international undertaking it may have entered into. Typically, a starting point will be the law governing all official statistical activities. In some cases powers to issue the relevant census enactment are provided for in the country's constitution. Also, the international agreements entered into by countries (e.g., European Union) to carry out agricultural censuses constitute the necessary juridical basis.

Authority for the promulgation and execution of legislation

1.6 Powers to order the taking of a census vary with the legislative systems of the respective countries. In keeping with the general patterns of lawmaking, basic acts will emanate from the legislative assembly, usually with the formal assent of the Head of State. These in most cases empower a minister or charge the appropriate agency respectively to issue enforcement decrees and prescribe operational procedures.

1.7 While the authority in charge of technical work is generally the national statistics office, the census executing authority varies considerably from country to country.

Scope of census legislation

1.8 Broadly speaking, the general pattern followed in legislation is for a Principal Act to state principles or to institute a census or order its taking, perhaps setting up a special body for that purpose, and to empower a minister to prescribe rules and introduce amendments where otherwise a time-consuming parliamentary procedure would be needed.

1.9 Among the countries participating in the 1980 World Census of Agriculture, three had only a single section on census legislation and, at the other extreme, one country had as many as 47.

1.10 Countries differ with respect to the degree of detail in their census legislation. Some enactments even prescribe in detail the questions to be inserted in the questionnaires; in others, only general directives are given. In other cases, the legislative authority does not intervene at all, thus allowing full freedom of interpretation to the census executing authorities.

Contact with the respondent and obligatory collaboration

1.11 The law should mention the participation of the respondent in the agricultural census. Normally the text prescribes the freedom of access to holdings for the enumerators or invites respondents to give information at the data collection centres.

1.12 The legal obligation to cooperate in the census is a common denominator of all countries considered in this study. The taking of an agricultural census is considered a task of national interest in which all citizens and corporate bodies are expected to collaborate. Active participation of all persons and institutions involved in census operations, apart from their "civic responsibility", is technically essential. Refusal to give information, or the giving of false information, will place the entire census operation in jeopardy, whether a complete enumeration or a sample survey is being conducted.

1.13 The legal obligation to cooperate in the census concerns not only individual holders and corporate bodies operating agricultural holdings. In some countries all literate persons, especially if civil servants, may be required to collaborate as enumerators, supervisors, etc.

1.14 In other countries, generally the census enumeration does not need the obligatory participation of the population because it is conducted by the staff of the national statistics office or related government agencies.

Confidentiality of information and penalties

1.15 One of the most important conditions for the success of a census is the absolutely confidential treatment of the information provided by the respondents and the assurance that such information will be used only for statistical purposes. This should be firmly and clearly stated. In several cases 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 information.

1.16 Penalties are imposed mainly for two kinds of offenses: in the case of respondents, for non-participation or for giving false information; and for violation of confidentiality on the

part of enumerators and the authorities concerned. Other cases, such as mutilation or defacement of schedules, acts done *ultra vires*, use of information for personal purposes, etc., are also considered.

Suggested reading

FAO (1984). Agricultural census legislation.

UN (1992). Handbook of population and housing censuses: Part I, Planning, organization and administration of population and housing censuses. Studies in methods, Series F, No. 54.

ANNEX TO CHAPTER 1

EXAMPLE OF LEGISLATION

THE CASE OF CANADA
Extracts from the Statistics Act
March 1992



CHAPTER S-19

CHAPITRE S-19

An Act respecting statistics of Canada

Loi concernant la statistique du Canada

SHORT TITLE

TITRE ABRÉGÉ

Short title

1. This Act may be cited as the *Statistics Act*. 1970-71-72, c. 15, s. 1.

1. *Loi sur la statistique*. 1970-71-72, ch. 15, Titre abrégé art. 1.

STATISTICS CANADA

STATISTIQUE CANADA

Statistics bureau

Bureau de la statistique

3. There shall continue to be a statistics bureau under the Minister, to be known as Statistics Canada, the duties of which are

3. Est maintenu, sous l'autorité du ministre, un bureau de la statistique appelé Statistique Canada, dont les fonctions sont les suivantes :

(a) to collect, compile, analyse, abstract and publish statistical information relating to the commercial, industrial, financial, social, economic and general activities and condition of the people;

a) recueillir, compiler, analyser, dépouiller et publier des renseignements statistiques sur les activités commerciales, industrielles, financières, sociales, économiques et générales de la population et sur l'état de celle-ci;

(b) to collaborate with departments of government in the collection, compilation and publication of statistical information, including statistics derived from the activities of those departments;

b) collaborer avec les ministères à la collecte, à la compilation et à la publication de renseignements statistiques, y compris les statistiques qui découlent des activités de ces ministères;

(c) to take the census of population of Canada and the census of agriculture of Canada as provided in this Act;

c) recenser la population du Canada et faire le recensement agricole du Canada de la manière prévue à la présente loi;

(d) to promote the avoidance of duplication in the information collected by departments of government; and

d) veiller à prévenir le double emploi dans la collecte des renseignements par les ministères;

(e) generally, to promote and develop integrated social and economic statistics pertaining to the whole of Canada and to each of the provinces thereof and to coordinate plans for the integration of those statistics. 1970-71-72, c. 15, s. 3.

e) en général, favoriser et mettre au point des statistiques sociales et économiques intégrées concernant l'ensemble du Canada et chacune des provinces, et coordonner des projets pour l'intégration de telles statistiques. 1970-71-72, ch. 15, art. 3.

Oath of office

Serment professionnel

6. (1) The Chief Statistician and every person employed or deemed to be employed pursuant to this Act shall, before entering on his duties, take and subscribe the following oath or solemn affirmation:

6. (1) Le statisticien en chef et toute personne employée ou réputée être employée en application de la présente loi, avant d'entrer en fonctions, prêtent le serment, ou font l'affirmation solennelle, qui suit :

I,, do solemnly swear (or affirm) that I will faithfully and honestly fulfil my duties as an employee of Statistics Canada in conformity with the requirements of the *Statistics Act*, and of all rules and instructions thereunder and that I will not without due authority in that behalf disclose or make known any matter or thing that comes to my knowledge by reason of my employment.

Je,, jure (ou affirme) solennellement que j'exercerai fidèlement et honnêtement mes fonctions d'employé de Statistique Canada en conformité avec les prescriptions de la *Loi sur la statistique*, ainsi que toutes règles et instructions établies sous son régime, et que je ne révélerai ni ne ferai connaître, sans y avoir été dûment autorisé(e), rien de ce qui parviendra à ma connaissance du fait de mon emploi.

SECURITY

SECRET

Prohibition
against
divulging
information

17. (1) Except for the purpose of communicating information in accordance with any conditions of an agreement made under section 11 or 12 and except for the purposes of a prosecution under this Act but subject to this section,

(a) no person, other than a person employed or deemed to be employed under this Act, and sworn under section 6, shall be permitted to examine any identifiable individual return made for the purposes of this Act; and

(b) no person who has been sworn under section 6 shall disclose or knowingly cause to be disclosed, by any means, any information obtained under this Act in such a manner that it is possible from the disclosure to relate the particulars obtained from any individual return to any identifiable individual person, business or organization.

17. (1) Sous réserve des autres dispositions du présent article et sauf pour communiquer des renseignements conformément aux modalités des accords conclus en application des articles 11 ou 12 ou en cas de poursuites engagées en vertu de la présente loi :

a) nul, si ce n'est une personne employée ou réputée être employée en vertu de la présente loi et qui a été assermentée en vertu de l'article 6, ne peut être autorisé à prendre connaissance d'un relevé fait pour l'application de la présente loi;

b) aucune personne qui a été assermentée en vertu de l'article 6 ne peut révéler ni sciemment faire révéler, par quelque moyen que ce soit, des renseignements obtenus en vertu de la présente loi de telle manière qu'il soit possible, grâce à ces révélations, de rattacher à un particulier, à une entreprise ou à une organisation identifiables les détails obtenus dans un relevé qui les concerne exclusivement.

Protection des
renseignementsPOPULATION CENSUS AND AGRICULTURE
CENSUSRECENSEMENT DE LA POPULATION ET
RECENSEMENT AGRICOLEPopulation
census

19. (1) A census of population of Canada shall be taken by Statistics Canada in the month of June in the year 1971, and every fifth year thereafter in a month to be fixed by the Governor in Council.

19. (1) Le recensement de la population du Canada est fait par Statistique Canada à tous les cinq ans, à compter de juin 1971, dans le mois qui est fixé par le gouverneur en conseil.

Recensement
de la populationCounts of
electoral
divisions

(2) The census of population shall be taken in such a manner as to ensure that counts of the population are provided for each federal electoral district of Canada, as constituted at the time of each census of population.

(2) Le recensement de la population est fait de façon à veiller à ce que le dénombrement de la population soit établi pour chaque circonscription électorale fédérale du Canada, telle qu'elle est constituée lors du recensement.

Dénombrement
par division
électoraleDecennial
census

(3) A reference in any Act of Parliament, in any order, rule or regulation or in any contract or other document made thereunder to a decennial census of population shall, unless the context otherwise requires, be construed to refer to the census of population taken by Statistics Canada in the year 1971 or in any tenth year thereafter. 1970-71-72, c. 15, s. 18.

(3) Lorsque, dans une loi fédérale ou dans une ordonnance, un décret, un arrêté, une règle, un règlement ou dans un contrat ou autre document qui en découle, il est fait mention d'un recensement décennal de la population, cette mention doit, sauf si le contexte s'y oppose, être interprétée comme désignant le recensement de la population fait par Statistique Canada en 1971 ou dans la dernière année de l'une des décennies subséquentes. 1970-71-72, ch. 15, art. 18.

Recensement
décennalAgriculture
census

20. A census of agriculture of Canada shall be taken by Statistics Canada

(a) in the year 1971 and in every tenth year thereafter; and

(b) in the year 1976 and in every tenth year thereafter, unless the Governor in Council otherwise directs in respect of any such year. 1970-71-72, c. 15, s. 19.

20. Un recensement agricole du Canada est fait par Statistique Canada :

a) à tous les dix ans, à compter de l'année 1971;

b) à tous les dix ans, à compter de l'année 1976, sauf, éventuellement, dans les cas où le gouverneur en conseil en décide autrement. 1970-71-72, ch. 15, art. 19.

Recensement
agricoleCensus
questions

21. (1) The Governor in Council shall, by order, prescribe the questions to be asked in any census taken by Statistics Canada under section 19 or 20.

21. (1) Le gouverneur en conseil prescrit, par décret, les questions à poser lors d'un recensement fait en vertu des articles 19 ou 20.

Questions
posées

Publication

(2) Every order made under subsection (1) shall be published in the *Canada Gazette* not later than thirty days after it is made. 1970-71-72, c. 15, s. 20.

(2) Chaque décret pris en vertu du paragraphe (1) est publié dans la *Gazette du Canada* au plus tard trente jours après qu'il a été pris. 1970-71-72, ch. 15, art. 20.

Publication

GENERAL STATISTICS

General
statistics

22. Without limiting the duties of Statistics Canada under section 3 or affecting any of its powers or duties in respect of any specific statistics that may otherwise be authorized or required under this Act, the Chief Statistician shall, under the direction of the Minister, collect, compile, analyse, abstract and publish statistics in relation to all or any of the following matters in Canada:

- (a) population;
- (b) agriculture;
- (c) health and welfare;
- (d) law enforcement, the administration of justice and corrections;
- (e) government and business finance;
- (f) immigration and emigration;
- (g) education;
- (h) labour and employment;
- (i) commerce with other countries;
- (j) prices and the cost of living;
- (k) forestry, fishing and trapping;
- (l) mines, quarries and wells;
- (m) manufacturing;
- (n) construction;
- (o) transportation, storage and communication;
- (p) electric power, gas and water utilities;
- (q) wholesale and retail trade;
- (r) finance, insurance and real estate;
- (s) public administration;
- (t) community, business and personal services; and
- (u) any other matters prescribed by the Minister or by the Governor in Council. 1970-71-72, c. 15, s. 21; 1976-77, c. 54, s. 74.

STATISTIQUE GÉNÉRALE

Statistique
générale

22. Sans pour autant restreindre les fonctions attribuées à Statistique Canada par l'article 3 ni porter atteinte à ses pouvoirs ou fonctions concernant des statistiques déterminées qui peuvent être par ailleurs autorisées ou exigées en vertu de la présente loi, le statisticien en chef doit, sous la direction du ministre, recueillir, compiler, analyser, dépouiller et publier, en ce qui concerne le Canada, des statistiques sur tout ou partie des sujets suivants :

- a) population;
- b) agriculture;
- c) santé et protection sociale;
- d) application des lois, administration de la justice et services correctionnels;
- e) finances publiques, industrielles et commerciales;
- f) immigration et émigration;
- g) éducation;
- h) travail et emploi;
- i) commerce extérieur;
- j) prix et coût de la vie;
- k) forêts, pêches et piégeage;
- l) mines, carrières et puits;
- m) fabrication;
- n) construction;
- o) transport, entreposage et communications;
- p) services d'électricité, de gaz et d'eau;
- q) commerce de gros et de détail;
- r) finance, assurance et immeuble;
- s) administration publique;
- t) services communautaires, commerciaux, industriels et personnels;
- u) tous autres sujets prescrits par le ministre ou par le gouverneur en conseil. 1970-71-72, ch. 15, art. 21; 1976-77, ch. 54, art. 74.

OFFENCES AND PUNISHMENT

Desertion or
false declaration

30. Every person who, after taking the oath set out in subsection 6(1),

- (a) deserts from his duty, or wilfully makes any false declaration, statement or return in the performance of his duties,
 - (b) in the pretended performance of his duties, obtains or seeks to obtain information that the person is not duly authorized to obtain, or
 - (c) contravenes subsection 17(1)
- is guilty of an offence and liable on summary conviction to a fine not exceeding one thousand dollars or to imprisonment for a term not exceeding six months or to both. 1970-71-72, c. 15, s. 28.

INFRACTIONS ET PEINES

Abandon de
fonctions ou
fausse
déclaration

30. Est coupable d'une infraction et passible, sur déclaration de culpabilité par procédure sommaire, d'une amende maximale de mille dollars et d'un emprisonnement maximal de six mois, ou de l'une de ces peines, quiconque, après avoir prêté le serment énoncé au paragraphe 6(1), selon le cas :

- a) abandonne ses fonctions, ou fait volontairement une fausse déclaration ou un faux relevé dans l'exercice de ses fonctions;
- b) sous prétexte de l'accomplissement de ses fonctions, obtient ou cherche à obtenir des renseignements qu'il n'est pas dûment autorisé à obtenir;
- c) contrevient au paragraphe 17(1). 1970-71-72, ch. 15, art. 28.

False or
unlawful
information

31. Every person who, without lawful excuse,

(a) refuses or neglects to answer, or wilfully answers falsely, any question requisite for obtaining any information sought in respect of the objects of this Act or pertinent thereto that has been asked of him by any person employed or deemed to be employed under this Act, or

(b) refuses or neglects to furnish any information or to fill in to the best of his knowledge and belief any schedule or form that the person has been required to fill in, and to return the same when and as required of him pursuant to this Act, or knowingly gives false or misleading information or practises any other deception thereunder

is, for every refusal or neglect, or false answer or deception, guilty of an offence and liable on summary conviction to a fine not exceeding five hundred dollars or to imprisonment for a term not exceeding three months or to both. 1970-71-72, c. 15, s. 29.

31. Est, pour chaque refus, négligence, fausse déclaration ou fraude, coupable d'une infraction et passible, sur déclaration de culpabilité par procédure sommaire, d'une amende maximale de cinq cents dollars et d'un emprisonnement maximal de trois mois, ou de l'une de ces peines, quiconque, sans excuse légitime :

a) soit refuse ou néglige de répondre, ou donne volontairement une réponse fausse, à une question indispensable à l'obtention de renseignements recherchés dans le cadre de la présente loi ou se rapportant à ces renseignements, et qui lui est posée par une personne employée ou réputée être employée en vertu de la présente loi;

b) soit refuse ou néglige de fournir des renseignements ou de remplir au mieux, d'après ce qu'il sait ou croit savoir, un questionnaire ou une formule qu'il a été requis de remplir, et de les transmettre au moment et de la manière fixés en application de la présente loi, ou sciemment donne des renseignements faux ou trompeurs ou commet toute autre fraude sous le régime de la présente loi. 1970-71-72, ch. 15, art. 29.

Renseigne-
ments faux ou
illégaux

Refusal to
grant access to
records

32. Every person

(a) who, having the custody or charge of any documents or records that are maintained in any department or in any municipal office, corporation, business or organization, from which information sought in respect of the objects of this Act can be obtained or that would aid in the completion or correction of the information, refuses or neglects to grant access to the information to any person authorized for the purpose by the Chief Statistician, or

(b) who otherwise in any way wilfully obstructs or seeks to obstruct any person employed in the execution of any duty under this Act

is guilty of an offence and liable on summary conviction to a fine not exceeding one thousand dollars or to imprisonment for a term not exceeding six months or to both. 1970-71-72, c. 15, s. 30.

32. Est coupable d'une infraction et passible, sur déclaration de culpabilité par procédure sommaire, d'une amende maximale de mille dollars et d'un emprisonnement maximal de six mois, ou de l'une de ces peines, quiconque, selon le cas :

a) ayant la garde ou la charge de documents ou archives conservés dans un ministère ou dans un bureau municipal, une personne morale, entreprise ou organisation et dont on pourrait tirer des renseignements recherchés pour les objets de la présente loi ou qui aideraient à compléter ou à corriger ces renseignements, refuse ou néglige d'en permettre l'accès à une personne autorisée à cet effet par le statisticien en chef;

b) autrement, volontairement, fait obstacle ou cherche à faire obstacle d'une façon quelconque à une personne chargée d'exercer une fonction prévue par la présente loi. 1970-71-72, ch. 15, art. 30.

Refus de
permettre
l'accès aux
archives

Leaving notice
at house

33. (1) The leaving by an enumerator, agent or other person employed or deemed to be employed under this Act, or the delivery by the post office at any house of any schedule or form purporting to be issued pursuant to this Act, and having thereon a notice requiring that it be filled in and signed within a stated time by

33. (1) Le fait qu'un recenseur, un agent ou une autre personne employée ou réputée être employée en vertu de la présente loi a laissé dans une maison ou un logement ou que la poste y a livré un questionnaire ou une formule paraissant avoir été établi en application de la présente loi, et qui contient un avis requérant

Avis laissé à
domicile

the occupant of the house, or in his absence by some other member of the family, is, as against the occupant, a sufficient requirement so to fill in and sign the schedule or form notwithstanding that the occupant is not named in the notice, or personally served therewith.

Leaving notice
at office

(2) The leaving by an enumerator, agent or other person employed or deemed to be employed under this Act, at the office or other place of business of any person or the delivery by the post office to any person or his agent, of any schedule or form purporting to be issued pursuant to this Act, and having thereon a notice requiring that it be filled in and signed within a stated time is, as against the person, a sufficient requirement so to fill in and sign the schedule or form, and if so required in the notice, to mail the schedule or form within a stated time to Statistics Canada. 1970-71-72, c. 15, ss. 31, 32.

Disclosing
secret
information

34. Every person who, after taking the oath set out in subsection 6(1),

- (a) wilfully discloses or divulges directly or indirectly to any person not entitled under this Act to receive the same any information obtained by him in the course of his employment that might exert an influence on or affect the market value of any stocks, bonds or other security or any product or article, or
- (b) uses any information described in paragraph (a) for the purpose of speculating in any stocks, bonds or other security or any product or article

is guilty of an offence and liable on summary conviction to a fine not exceeding five thousand dollars or to imprisonment for a term not exceeding five years or to both. 1970-71-72, c. 15, s. 33.

Personation of
Statistics
Canada
employee

35. Every person who

- (a) personates an employee of Statistics Canada for the purpose of obtaining information from any person, or
- (b) represents himself to be making an inquiry under the authority of this Act when

que le questionnaire ou la formule soit rempli et signé, dans un délai déterminé, par l'occupant de cette maison ou de ce logement, ou en son absence par un autre membre de la famille, constitue, pour l'occupant, une injonction suffisante de remplir et de signer le questionnaire ou la formule, bien que l'occupant ne soit pas nommément désigné dans l'avis, ou qu'il n'en ait pas reçu signification personnelle.

Avis laissé au
bureau

(2) Le fait qu'un recenseur, un agent ou une autre personne employée ou réputée être employée en vertu de la présente loi a laissé au bureau ou autre lieu d'affaires d'une personne ou que la poste a livré à une personne ou à son agent un questionnaire ou une formule paraissant établi en application de la présente loi, et qui contient un avis requérant que le questionnaire ou la formule soit rempli et signé dans un délai déterminé, constitue, pour cette personne, une injonction suffisante de remplir et de signer le questionnaire ou la formule, ainsi que de l'expédier par la poste, à Statistique Canada, dans un délai déterminé, si l'avis le requiert. 1970-71-72, ch. 15, art. 31 et 32.

Révélation de
renseignements
secrets

34. Est coupable d'une infraction et passible, sur déclaration de culpabilité par procédure sommaire, d'une amende maximale de cinq mille dollars et d'un emprisonnement maximal de cinq ans, ou de l'une de ces peines, quiconque, après avoir prêté le serment énoncé au paragraphe 6(1) :

- a) soit, volontairement, révèle ou divulgue, directement ou indirectement, à quiconque n'est pas autorisé par la présente loi à les obtenir, des renseignements qu'il a obtenus dans l'exercice de ses fonctions et qui pourraient avoir une influence ou une incidence sur la valeur marchande d'actions, d'obligations ou autres valeurs ou d'un produit ou article;
- b) soit se sert de tels renseignements pour spéculer sur des actions, obligations ou autres valeurs ou sur un produit ou article. 1970-71-72, ch. 15, art. 33.

Usurpation de
la qualité
d'employé de
Statistique
Canada

35. Est coupable d'une infraction et passible, sur déclaration de culpabilité par procédure sommaire, d'une amende maximale de mille dollars et d'un emprisonnement maximal de six mois, ou de l'une de ces peines, quiconque :

the person is not an officer, employee or agent of Statistics Canada, is guilty of an offence and liable on summary conviction to a fine not exceeding one thousand dollars or to imprisonment for a term not exceeding six months or to both. 1970-71-72, c. 15, s. 34.

a) soit se fait passer pour un employé de Statistique Canada aux fins d'obtenir de quelqu'un des renseignements;

b) soit se présente comme faisant une enquête sous l'autorité de la présente loi alors qu'il n'est pas un fonctionnaire, employé ou agent de Statistique Canada. 1970-71-72, ch. 15, art. 34.

Application of fines

36. All fines imposed pursuant to this Act belong to Her Majesty in right of Canada and shall be paid to the Receiver General. 1970-71-72, c. 15, s. 35.

36. Toute amende imposée en application de la présente loi appartient à Sa Majesté du chef du Canada et est versée au receveur général. 1970-71-72, ch. 15, art. 35.

Imputation des amendes

Limitation period

37. Any proceedings by way of summary conviction in respect of an offence under this Act may be instituted at any time within but not later than two years after the time when the subject-matter of the proceedings arose. 1970-71-72, c. 15, s. 36.

37. Les poursuites sommaires relatives à une infraction à la présente loi se prescrivent par deux ans à compter de sa perpétration. 1970-71-72, ch. 15, art. 36.

Prescription

CHAPTER 2

CENSUS COMMITTEE

In many countries the agricultural census is organized only once in ten years, and a permanent census organization does not exist. The agricultural census, being a major operation, involves different national ministries or agencies, and considerable financial and personnel resources. An inter-ministerial committee is considered essential to guide and coordinate all census activities.

The purpose of this chapter is to provide a broad outline of the composition of the committee, a tentative description of its responsibilities, and its possible extension to provincial and lower levels. Details in this respect will vary greatly from country to country, depending also whether a committee for statistics already exists in the country.

Composition of the committee

2.1 The establishment of a committee to act as a steering group is essential for the successful implementation of the census. This committee may be known as the "Agricultural Census Steering Committee". It has to be established well ahead of time, invested with the necessary authority, provided with material support and staffed with high-level personnel. It should be an organ created by the regulatory text establishing the census. 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 report.

2.2 While the composition of the committee would depend on the head of the census office, as a general rule all the various aspects of the operation should be represented. This Committee should consist of representatives from all important federal government agencies directly or indirectly concerned with census taking or are possible users of census results, as well as non-governmental organizations interested in the census. Ministries responsible for agriculture, cooperation and district administrations, the Ministry of Finance or Budget, and the statistical agencies entrusted with the task of carrying out the census. Farmers' organizations, industry and trade associations particularly concerned with agricultural products, should also be represented on the committee. It is essential that the committee members be high-ranking officials who are in a position to take decisions and direct the census operation. Its chairperson could be the chief of the agriculture department or Central Bureau of Statistics with the national agricultural census coordinator acting as secretary to facilitate coordination among members. The number of members will vary depending on the scope and coverage of the census, but care should be taken that the group is not so large as to become unmanageable. An example of an Agricultural Census Committee is given in frame 2.1.

Main responsibilities and functions

2.3 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 head of the statistical office. 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 approve the census workplan, scope and coverage, methodology, questionnaires, manuals, budgetary and personnel requirements, plans for the publicity campaign, logistical needs, pre-test and pilot censuses, post-enumeration survey plans, tabulation plan, data processing and data dissemination. Meetings should be held 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.

Establishment of sub-committees and working groups

2.4 Due to the broad functions and activities of the Steering Committee, it may be appropriate to establish sub-committees. Sub-committees and working groups 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 technical matters (technical sub-committee) 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.

Establishment of provincial¹ committees

2.5 For administrative reasons, countries are usually divided into several administrative divisions and these divisions have their own agro-economic characteristics. In large countries it may be desirable to establish provincial census committees in broad administrative divisions. The main functions of such provincial committees would be to coordinate the census activities at the provincial level, to make recommendations for items of information specific to the province to be included in the questionnaires and to advise on provincial tabulations.

Chairmanship: State Institute of Statistics (SIS)

Ministry of Agriculture and Rural Affairs
 Ministry of Forestry
 Ministry of Interior
 State Planning Organization
 General Directorate of Soil and Agricultural Reform
 National Productivity Centre
 General Directorate of Soil Products Office
 Scientific and Technical Research Council of Turkey
 Food and Agricultural Organization (FAO) of UN
 Union of Turkish Chamber of Agriculture
 Turkish Milk Industry
 Meat and Fish Industry
 Meat and Fish Organization
 General Commandership of Cartography
 General Directorate of Title Deeds and Cadaster
 General Directorate of Protection and Control
 Ziraat Bank of Turkish Republic
 Ankara University, Faculty of Agriculture
 Ankara University, Faculty of Veterinary
 Middle East Technical University, Departments of
 Statistics and Economics
 Hacettepe University, Departments of Statistics and
 Economics
 Gazi University, Departments of Statistics and
 Economics

Source: General Agricultural Census results of the agricultural holdings (households) survey, State Institute of Statistics, Prime Ministry, Republic of Turkey, 1991

Frame 2.1 Example of Census Committee: Composition of the Committee for the Census of Agriculture in Turkey (1991)

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

Other boards/committees

2.6 Where various agencies are called upon to participate in the census effort, coordinating boards would be necessary to effect an efficient operation. Such boards may have to be established for the field operations phase at the district administrative subdivisions. It may also be desirable for a national coordinating board to have its local counterparts where plans from the top are filtered down to the lowest level. The national coordinating board's membership should be at the departmental level or its equivalent, because such a board should be responsible for committing the department's participation in the census operation and in ensuring that its field branches carry out the policies and plans as laid out. The local counterparts can be at the provincial level down to the lowest administrative unit. Primarily, their function is to coordinate the implementation of the policies and guidelines adopted by the national board and to provide the assistance required by the census field office. These boards would be useful in resolving boundary disputes, providing protection to the enumerators, providing transportation and communication facilities, and in publicizing the operation. An added fringe benefit to the census organization would be the sense of participation acquired by the agencies and the awareness of statistics.

CHAPTER 3

WORK PLAN, BUDGET AND EXPENDITURE CONTROL

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

- *establishing a work plan for the census; a checklist of the various key activities to be undertaken and relating them sequentially to each other within the time frame for the whole census.*
- *setting up simultaneously a financial outline and a budget, broken down to reflect the budget calendar and budget procedure of the country;*
- *constructing procedures to monitor the progress of individual operations, mainly to control expenditure.*

The reader's attention is drawn to the importance of the recommendations in this chapter and particularly to those referring to the need for realistic estimates when preparing the budget. Inadequate planning and/or underestimating the financial requirements are the basic reasons in many countries for serious problems in census operations. Also, very important, is an awareness of the time and resource requirements for this operation. It should be known, especially by producers and users of data, that an agricultural census cannot be accomplished in a short time. Time is an essential dimension that should never be forgotten and even for a small census, at least two years is required from the initial preparatory work to the dissemination of the census results.

The work plan

3.1 The work plan is usually presented as a chart (see example in Table 3.1) identifying all the key activities of the census in a time frame (preparation, field work, etc.) and showing the relationship between them. Time is usually shown in weeks, months or quarters on the horizontal axes. Each row refers to a key activity with a bar showing when it is active. The comparison between bars demonstrates obvious relations between activities in time. Some information may be added to indicate possible flexibility of the relation; a well-prepared work plan should show, for instance, that enumeration cannot start before questionnaires are available.

3.2 Given the great number of specific activities, it is often more practical to break down the general work plan into several broad subject matter areas or phases; thus, one can prepare a field enumeration work plan, a training work plan, a data processing work plan, etc. In this case, the census coordinator must ensure the necessary consistency of these work plans. There are now several software packages available to assist in project planning and monitoring.

3.3 The assessment of the length of each activity must rely on realistic information from previous similar operations. The pilot census (see Chapter 13), carried out under conditions closely resembling the actual census, may also provide good estimates of time and resource requirements.

Table 3.1 Example of General Work Plan

Activity	Year 1				Year 2				Year 3				Year 4			
Census legislation																
General preparations																
Tabulation plan																
User meetings																
Holding listing																
Pilot census																
Questionnaire design																
Manuals																
Printing documents																
Distribution of material																
Training																
Enumeration																
Quality controls																
Preliminary results																
Data processing - coding																
- data entry																
- tabulation																
Analysis & dissemination																

3.4 The importance of a well-thought out work plan should not be underestimated. For this purpose, a network analysis can be useful. For large operations like censuses, 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. For example, a delay in the arrival of training materials at training centres would mean re-assembling hundreds of census field workers for training. Certain decisions, such as training of key office personnel and purchase of computers should be taken at a very early stage. The scheduling of the work plan, therefore, should be such that ample time is allowed for all materials to arrive at their respective destinations in time. In addition, the work plan should also take into account local conditions and transportation facilities. The time set for

training and enumeration should be such that they are not interrupted. Questionnaires and other materials should not be exposed to the danger of getting wet and spoiled, such as during the rainy season. It should also be kept in mind that in many countries agricultural activities depend on the agricultural season, so the date of enumeration has to be planned accordingly.

3.5 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 time needed to access and enumerate an average 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. This information is indispensable for estimating the number of enumerators or number of data entry machines and operators required in order to accomplish the operation within the time scheduled in the work plan. 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.

The financial outline

3.6 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 N computers are required at US\$ C each for data entry, the cost of purchasing computers for data entry would be US\$ $N \times C$.
- (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, reports, manuals, etc.) including the fixed costs and the variable costs where unit costs may decrease with quantity.

3.7 The assessments of time, assessments of cost (flat rate, fixed or variable) must be based on realistic price estimates obtained from previous experiences or by experts in the field. For printing costs, estimates from printers are clearly the best solution.

3.8 All costing should be specifically identified and cover each of the three main census phases:

- 3.8.1 **Pre-enumeration phase.** The financial outline should consider estimates for activities covering planning and other preparatory work (including work plan and budget), such as frame preparation and obtaining/purchasing required cartographic material, aerial photographs, satellite imagery; determination of concepts and terms, questionnaire content; preparation of tabulation plan; training programmes and instruction manuals for field operations; determination of manpower requirements; logistics; preparation of data processing procedures and computer programs; preparation of administrative control and reporting forms; choice of survey design and/or determination of sample size (in the case of sample enumeration) and conducting pre-tests and pilot census; printing of questionnaires and other forms; planning equipment requirements for data processing (including software), transport, etc., and purchase and/or rental of this equipment; preparation of maps and other instructional materials; training of central office personnel, etc.

- 3.8.2 **Field operation phase.** The costs for this phase should reflect estimates for recruitment and training of field staff and supervisors; number and employment period of each type of worker; distribution and collection of questionnaires; post-enumeration survey (PES); quality control; and shipment of completed questionnaires to the respective provincial offices or central office.
- 3.8.3 **Post-enumeration phase.** The cost estimates for this phase should reflect cost for total man-days required and workload of activities involving receipt and control of documents; all phases of data processing (manual editing, data entry, verification and validation, and tabulation); analysis and publication of census results and publication of administrative reports, and all other activities of dissemination.
- 3.9 The other costs are:
- 3.9.1 **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.
- 3.9.2 **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 computer(s) data entry equipment, etc., should be provided for in the appropriate fiscal year. Requirement of transport vehicles should also be estimated.
- 3.9.3 **Printing costs:** An agricultural census has a huge printing programme. 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. The printing requirement of published reports will run into several hundred pages.
- 3.9.4 **Office expenses and miscellaneous costs** may include hiring of office space and furniture, purchase of stationery, 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.

Preparation of the budget

3.10 For censuses, as for any statistical operation, the budget should be prepared in accordance with the rules and regulations of the government. 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. It can be set up directly from the financial outline by aggregating costs of specific activities according to the financial time schedule and regulations of the country. It is generally less detailed than the financial outline and may present, for instance, all salaries and wages regrouped by year even if the staff requirements of the census vary largely, beginning with a fairly small technical group of persons for preparatory work, subsequently an army of enumerators and supervisors for the enumeration, followed by the recruitment of personnel required for data processing and finally for activities of dissemination. Each financial plan should have built in some

contingency allowance for inflation and unexpected expenses. In estimating the expenditure on salaries of personnel for every financial year, this distribution of the number and type of persons who would be working on the census has to be accurately provided. Furthermore, the primary enumerators and field supervisors would be working temporarily for the census and some honoraria may have to be paid to them. This amount is generally substantial, and needs to be foreseen in the work plan and budget for the appropriate financial year.

3.11 In large countries with socio-economic conditions varying from province to province, it may be more realistic to prepare a budget for each province separately and then pool them together to arrive at a country budget. For example, in large countries, transport and communication facilities may not exist uniformly in all the provinces. Separate estimates of travel and transport costs will have to be made for individual provinces.

3.12 Presentation and adoption of the budget vary depending on the form or style adopted or practices followed by the country. Two sample budgets are shown in Tables 3.2 and 3.3.

Review of the work plan, the budget and frequency

3.13 Planning and scheduling of the census operation are prepared years in advance of the actual operation. Consequently, a periodic review of the work plan and its impact on the budget for any change of plan and schedule of operation, would be appropriate. This review, at least once each quarter, would suffice, as submission of the budget is usually made once a year.

Table 3.2 Example of budget for a Census in an African country with sample enumeration, intensive cartography work, several passages in holdings and area measurements

Unit: '000 US\$

Expenses/posts	Total	Year 1	Year 2	Year 3	Year 4
Preparatory studies, training, assistance, seminars	104	40	30	17	17
Census publicity	50	5	40	5	
Staff:					
Office staff	450	120	120	120	90
Enumerators	420	120	250	50	
Supervisors	38	8	25	5	
Data processing staff	26	9	12	5	
Materials:					
Vehicles, transport	175	175			
Survey materials	65	65			
Data processing equipment	50	50			
Other equipment	85	70	15		
Miscellaneous (including maintenance, repairs, various provisions...)	210	60	50	50	50
TOTAL	1673	722	542	252	157

Source: FAO Project document

Table 3.3 Provisional financial outline for the Census of Morocco
(complete enumeration, 1996)

Units: Dirhams (Dh)

Expenses/posts	Number	Value
Personnel:		
Managers	12	804 000
Data processing staff	280	8 400 000
Enumerators	933)
Controllers	160) 2 796 000
Supervisors	51)
Drivers	100	750 000
Support staff	100	750 000
Equipment:		
Computers and software		8 600 000
Vehicles		17 200 000
Other equipment		500 000
Other:		
Publicity campaign for the Census		1 000 000
Travel expenses		7 792 000
Printing of questionnaires and manuals		2 500 000
Printing of publications		400 000
Dissemination of the Census results, maps and cartographic material		100 000
Petrol and oil		6 000 000
Training materials (projectors & blackboards)		200 000
General expenses		1 000 000
TOTAL		58 792 000

Source: FAO Project Document

3.14 General review and coordination of changes in the plan are of great importance for large operations like a census. To better control the operations during the crucial period of census enumeration, 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. For this purpose, a monthly review would be required. 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.

Preparation of expenditure control

3.15 A large operation such as a census involves a large amount of expenditure which will necessitate the introduction of control procedures to ensure the efficient use of funds as required by the funding agency. An appropriate system should, therefore, be designed and put in place.

3.16 Once a system has been established, written guidelines on financial policies and procedures should be prepared. For a census office which usually operates through its field personnel at various administrative levels, an efficient cost and control system would ensure an easy flow and control of funds from the central office to the field offices.

3.17 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 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. Field staff should be able to draw an amount, depending on the needs of the office, for the quarter but not beyond the cash ceiling allowance for that particular item of operating expenses.

3.18 In the meantime, the budget staff of 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 whereby every type of expenditure would be identified with a code number would make computerization possible.

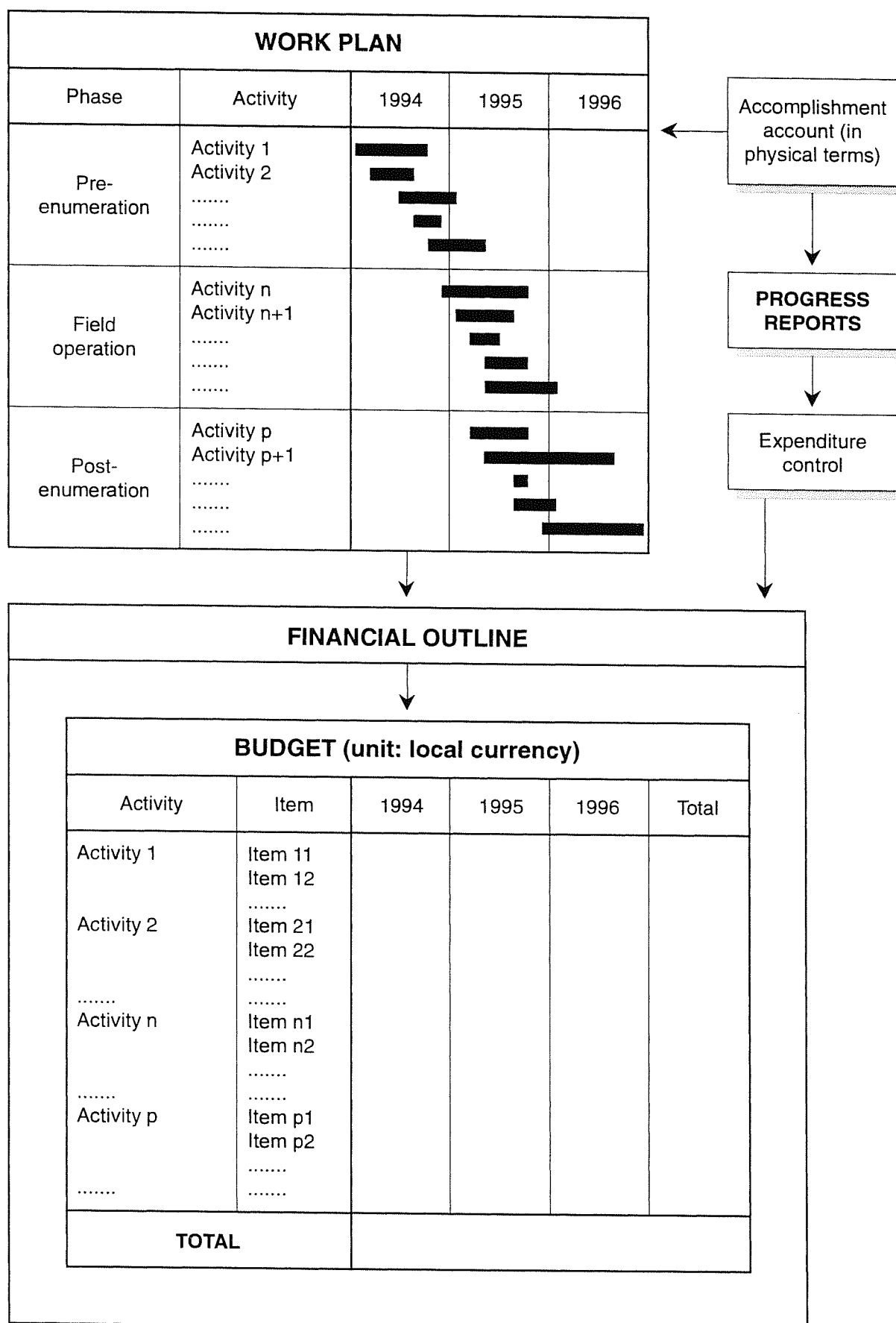
3.19 A prerequisite for establishing expenditure control is the availability of information on expenditure incurred and the corresponding output of work. It is therefore desirable to develop a system of progress reports at regular intervals, say once a month. Progress reports should be compatible with the form in which both the work plan and the financial outline 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 and for the year as a whole. These data can then be matched with achievements of the relevant period.

3.20 Relations between the work plan, expenditure control and financial outline are presented in Figure 3.1.

Suggested reading

UN (1992). Handbook of population and housing censuses: Part I, Planning, organization and administration of population and housing censuses. Studies in methods, Series F, No. 54.

Figure 3.1 Diagram showing links between work plan and budget



CHAPTER 4

CENSUS STAFF

This chapter deals with staff requirements for conducting an agricultural census. Census staff, under the responsibility of a census coordinator, are basically composed of two categories of personnel: the census office, including professionals of various specialities, and the field personnel. The success of the census depends on the efficiency, quality and dedication of the census staff. Proper staff selection and adequate training are necessary for a successful census.

In some countries there is often a lack of two critical groups of staff: subject matter specialists and field staff. Qualified specialists in areas such as data processing are often attracted by higher salaries in the private sector and there is frequently a shortage of qualified staff in statistical offices.

Many topics covered in this publication are closely related to census staff. The attention of readers is drawn particularly to the Training Programme (Chapter 12), and to the Organization of Field Work (Chapter 15).

Introduction

4.1 The staff requirements for an agricultural census can be divided into two categories of personnel:

- (i) Personnel needed for overall management of the census, planning and executing the census operations, including training of field personnel, data processing and analysis, publication and dissemination of census results. These personnel constitute the census office staff.
- (ii) Personnel for field operations, including data collection and supervision activities. These personnel constitute the field staff.

4.2 All members of the census staff 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.

Census coordinator

4.3 The head of the census organization should be the national census coordinator and the leader of the census staff. This person 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.

Members of the census office

4.4 The first category of personnel in the census office would be in charge of planning the technical aspects of the data collection, analysis and publication including developing the methodology and all technical documentation, recruiting and training field staff,

monitoring field operations, designing the tabulation and analysis plan, analyzing the data and drafting the final report. This category should include individuals with degrees in mathematics or statistics and formal training in statistical methods and sampling techniques. These individuals should be specialized in the following fields:

- (i) Agricultural census organization and monitoring.
- (ii) Agricultural survey methodology and sampling techniques.
- (iii) Training of field staff.
- (iv) Quality control, data tabulation, analysis and dissemination.

Members of the census working groups should be able to deal with specialists of other fields. Some general professional staff would complete routine work, editing and checking questionnaires, and computer output, etc.

4.5 A second category of personnel in the census office includes data processing staff. Data processing could be done in the census office or in decentralized locations. A group of personnel would be in charge of all data processing aspects of the census, including the organization of data processing activities, management of data entry personnel, elaborating data entry and editing programs and tabulation programs. Where possible, these personnel should include individuals with degrees in computer science (analysts, programmers) and experience in census and survey data processing. When these staff are not available, extensive training may be necessary. In addition to these personnel, staff are needed for data entry, manual coding and editing, including correction of errors detected by computers. These staff should have at least high school education and may be recruited from successful field enumerators and supervisors.

4.6 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 usually a major task which should be completed in a short time (usually one to two years). Under the circumstances it may be advisable to seek help from other government agencies or from existing data processing agencies on a commercial basis.

4.7 Support staff including typists, clerks, accountants, and logistics personnel should complete the census office.

4.8 In large countries, a provincial agricultural census coordinator, supported by trained and experienced statistical personnel, should 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.

Field staff

4.9 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 these staff, considering that the agricultural census is a comprehensive technical inquiry. At the base of the hierarchy is the field enumerator whose work is monitored by local supervisors; however, it should be recognized that these enumerators are the key to the success of the agricultural census. Provincial supervisors are appointed under the national and provincial census coordinators to provide quality control and technical guidance of field work.

4.10 Most of the field staff work under difficult conditions, often in remote areas. As a result, they do not have opportunities to meet other enumerators or higher-level supervisors.

Usually, enumerators and supervisors are recruited and trained locally. It is essential, therefore, that detailed and realistic instructions are given to these field staff in written form. Some suggestions in this respect are given below:

- 4.10.1 **Administrative 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 11). The place to make sure that enumerators and supervisors learn their duties, responsibilities and rights is at the training courses (see Chapter 12). 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. The work schedule should be specified; it may be very flexible but will normally involve working evenings, on Sundays and holidays, and should describe the frequency of meetings 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.
- 4.10.2 **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.
- 4.10.3 **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 (see para.4.17). 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.

Enumerators

4.11 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. They must be enthusiastic about the value and importance of the census for national development. They must set about their task 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 and to the nation at large.

4.12 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 dialect. Ideally, the enumerators should have the minimum of a high school education and preferably have a 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. Good enumerators are so important that consideration should be given to the possibility of recruiting them as permanent staff. This is justified if enough regular work is available, such as data collection of annual agricultural data or other subjects: demography, labour, health surveys, etc. 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.

4.13 Successful enumerators need a number of important characteristics. They need to be tactful, conscientious, motivated to work and resourceful in handling communication problems with respondents. They should be persons who, by their attitude, can obtain the respect and confidence of the household. They could be men or women, depending on the specific country situation. They must be willing and able to work full time until the job is completed. They should be persons who will work carefully and diligently when their supervisor is not present, and who will keep the required work records. They should be able to write very legibly, particularly figures. Most data entry errors are due to illegible entries.

4.14 It is important to recruit only the most capable persons as enumerators. Simple tests designed to measure the applicant's ability to read and apply instructions, understand maps, communicate with people, record information on questionnaires accurately, and perform arithmetical operations are suggested to be used in selecting qualified candidates. They should be interviewed by a team consisting of agricultural statisticians, agricultural extension specialists and land record officers who have experience in agricultural statistics and censuses.

4.15 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. They require special consideration if accurate data are to be obtained from such a group of households. The census enumeration is a strenuous job. It is, therefore, desirable to avoid the recruitment of enumerators who are too old or too young.

Supervisors

4.16 The enumerator's work is monitored by local supervisors who control the work and provide technical guidance, and who, in turn, are supervised by provincial supervisors. Supervision of the enumerator's work is an essential requirement for the success of any census.

4.17 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. Experience shows that five to ten enumerators for one local supervisor, and five to ten local supervisors under a provincial supervisor is a satisfactory workload. No savings should be attempted on the number of supervisors, particularly 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.

4.18 Local supervisors should have similar qualifications to those of enumerators but with a higher level of education and some administrative experience. Experienced enumerators often make good supervisors. Supervision 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.

4.19 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.

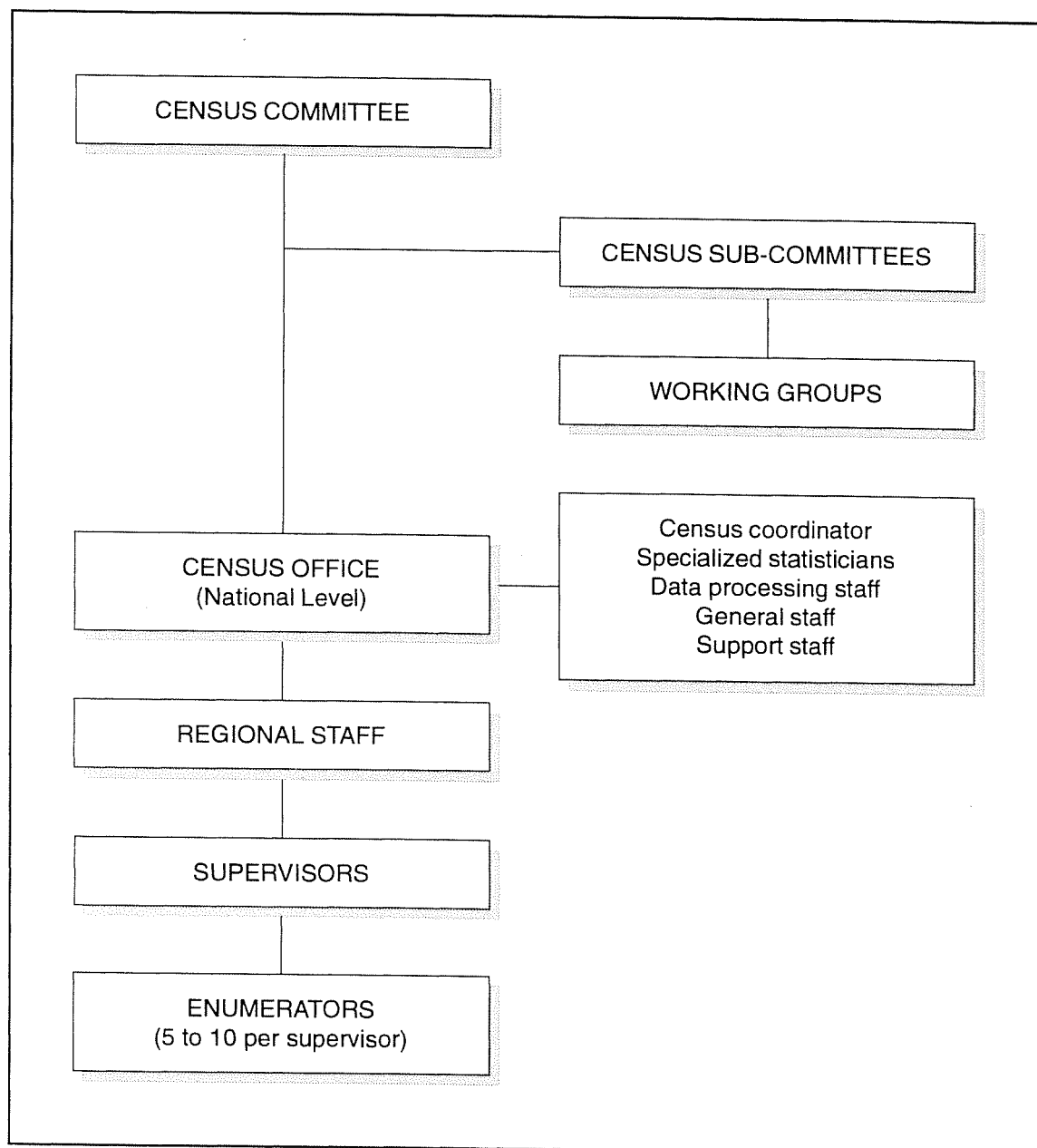
4.20 Supervisors need to give special attention to checking the accuracy of the boundaries of the enumeration area. They have to travel into these areas to ensure that the administrative borders are the same as those given to them. These visits will help them in allocating enumerators to various districts and suggesting any needed variations in the publicity, financial and/or administrative work.

Organizational aspects

4.21 The principal administrative and professional staff need to be highly skilled and qualified persons. They should be recruited from personnel who are familiar with agricultural census methods and procedures and government work. A thorough training of this staff is important.

4.22 The agricultural census is an important basis for developing and improving the ongoing system of agricultural statistics. After the census is completed, the resources developed and groundwork laid by the census such as equipment and trained field staff in particular, should be used as much as possible in various other statistical surveys. In formulating plans for the agricultural census, this possibility needs to be considered, as the agricultural census is part of the overall agricultural statistical system.

4.23 Finally, the success of the collection of census data will depend on how well the work has been organized, the quality and training of field enumerators and supervisors and how the government and public organizations have been mobilized to meet the major task of a census operation. The following Figure 4.1 is an example of an organizational chart of staff involved in a census.

Figure 4.1 Organizational Chart of Census Personnel*Suggested reading*

Idaikkadar N.M. (1979). Agricultural statistics: A handbook for developing countries. Pergamon Press, Oxford.

CHAPTER 5

CARTOGRAPHIC PREPARATION

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 or survey 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

5.1 Maps are used to produce more accurate, timely and useful statistical data. Maps are essential in planning the agricultural survey or census, for data collection, and for the presentation and analysis of results.

5.2 Maps of several types are used for agricultural census or survey purposes, that is maps related to the agricultural characteristics: topographic charts, cadastral maps, road maps, administrative area maps, maps showing the population distribution, aerial photographs, satellite images, space photographs, land use, soil or geologic maps, etc. Sketches are also sometimes used to help delineate the enumerators' areas of work.

5.3 This chapter deals with cartographic materials which are usually maps or sketches printed on paper. The attention of the reader should also be drawn to other kinds of support for maps, such as tapes, diskettes, CD-roms, which facilitate the use of maps, allowing changes of scales (see Frame 5.1 Scale on maps), geometric corrections, juxtaposition or superposition of thematic maps. Such maps on magnetic media constitute the basic components of Geographic Information Systems (GIS), which require the availability of experienced staff, powerful computers and software (see Chapter 6).

5.4 A pre-requisite for the use of maps is a comprehensive inventory of available maps that could be used for agricultural statistical purposes. In fact, the main task in cartographic preparations for an agricultural survey generally consists of adapting, revising and updating available maps to the survey requirements.

5.5 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 enumeration areas (EAs) which are components of the agricultural census frame. The

construction of the census frame should therefore be undertaken as part of the census field data collection preparatory activities (see Chapter 6).

5.7 The largest proportion of the cartographic support for an agricultural sample survey 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

5.8 Maps for conducting agricultural censuses and surveys have three main purposes:

5.8.1 Planning and supervising operations.

These are usually small-scale topographic maps, say 1/50,000, 1/100,000 or smaller, 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. They should provide the cartographic base for planning and organizing the statistical work, for instance to set up enumerators' assignments, assign geographic codes to proper statistical areas, estimate travel distances and directions, etc. Maps used for the construction of the frames are also included in this category of maps. 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.

5.8.2 **Field Data Collection.** Maps (or sketches) and/or photos for identifying enumeration areas (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, determine the best route of travel to and within the enumeration area, measure distances, determine directions, show the progress of the field work and, ideally, to identify the agricultural holdings (land and even buildings, if possible). Enumeration area 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.

5.8.3 **Presentation and analysis of 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

The most important parameter on a map is the **scale**, which is the ratio of representation of the magnitude of the land. The scale must always be present on a map and usually appears as a fraction spreading between 1/5,000 (large scale) to 1/1,000,000 or less (small scale).

1/5,000 means that 1 unit of length on the map represents 5,000 units of length on earth, i.e. 1 cm = 50m.

Large scales are used to represent small areas of earth; for example on an A4 sheet (21x29.7cm) one could place in width:

- 1 km at the scale 1/5,000
- but 200 km at the scale 1/1,000,000.

In other words, a country of 1,000kmx1,000km needs at least paper measuring 1mx1m to be totally represented and the scale cannot be larger than 1/1,000,000.

Thus, the choice of the scale depends on the purpose for which the map is to be used but attention should also be paid to paper size and, therefore, the manageability of the document, especially for field work.

Frame 5.1 Scale on maps

effectively. Atlases produced from the statistical results, are often useful publications (see Chapter 18).

Exploration of existing map resources inventory

5.9 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 maps. It is strongly recommended to prepare an inventory of existing maps including, at least, the following information:

- (i) Office responsible for the preparation.
- (ii) Date of publication or preparation.
- (iii) Date of the basic photography if made from aerial photos.
- (iv) Purpose of the preparation.
- (v) Area covered.
- (vi) Scale.
- (vii) Symbols.
- (viii) Projection.
- (ix) Cartographic references.
- (x) Technology used.

The map inventory should then be evaluated for census or survey use by cartographers.

Types of maps used

5.10 Many different types of maps can be used for the agricultural census or survey, for example:

5.10.1 **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.

5.10.2 **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.

5.10.3 **Satellite images.** Satellite images (available on paper or on magnetic media) 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:

- (a) 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
- (b) to monitor agricultural changes by using, for instance, vegetation indexes.

- 5.10.4 **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 6.
- 5.10.5 **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.
- 5.10.6 **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).
- 5.10.7 **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.
- 5.10.8 **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.

Timing of cartographic preparation

5.11 The timing of cartographic preparation is very important. Statistical offices should try to carry out cartographic work on a permanent basis in order to continuously update the statistical maps. This requires permanent specialized staff, which could be increased prior to and immediately following census and survey activities for the updating of maps with the necessary information.

5.12 The timing of the cartographic preparations naturally depends on the type of statistical operation, the desired geographic precision required for data collection and dissemination, the availability and accuracy of the basic cartography of the country, the number of maps needed, and other characteristics of the country like topography and land use.

5.13 To give an example, it should be mentioned that some large countries in Latin America have devoted no less than two years to census cartographic preparation.

Computer-assisted cartography

5.14 Computer-assisted cartographic systems can be very useful to continuously update maps for statistical purposes.

Suggested reading

U.S. Bureau of the Census. Mapping for Censuses and Surveys, Statistical Training Document, ISP-TR-3, Washington, D.C., 1978

U.S. Bureau of the Census. Mapping for Censuses and Surveys, Workbook, Statistical Training Document, ISP-TR-3W, Washington, D.C., 1978

CHAPTER 6

THE SURVEY DESIGN

The purpose of this chapter is to present an overview of the main survey designs used for conducting agricultural censuses and surveys.

After presenting the main types of survey design, list sample design and area sample design, other important uses of sampling techniques in the statistical work, are also mentioned, such as the application of sampling in quality control of the field and data processing operations, pre-testing of questionnaires, and various statistical operations. The construction of frames is discussed in Chapter 7.

The statistical theory and practice of survey design for agricultural surveys is beyond the scope of this publication, and the reader may consult the list of suggested references on survey methods for agricultural censuses and surveys included at the end of the chapter.

Objectives of agricultural censuses and surveys

6.1 In this publication, an agricultural census is defined as a large-scale, periodic, statistical operation for the collection of quantitative information on the structure of the agriculture of the country. As mentioned in the FAO Programme for the World Census of Agriculture 2000, the basic objectives of an agricultural census are:

- (i) To provide aggregate totals for fundamental agricultural data for use as the benchmark for inter-censal estimates.
- (ii) To provide a frame for other agricultural sample surveys.
- (iii) To provide data for small administrative units and detailed cross-classifications of holding structural attributes.

6.2 FAO recommends that each country should conduct at least one agricultural census in each census programme decade. The FAO Programme for the World Census of Agriculture 2000, for instance, corresponds to agricultural censuses to be undertaken during the decade 1996-2005.

6.3 Since the agricultural census is not a frequent data collection activity, it is natural to associate it with those aspects of agricultural structure which change relatively slowly. Census data are also useful in the design of annual or seasonal agricultural sample surveys. For example, stratification criteria for current surveys are included in the census questionnaire: sex and age of holder, total area, area by crops, number of livestock, number of trees, integration of holding with enterprises, etc. Clustering procedures and assignment of probabilities of selection for current agricultural surveys are also often based on agricultural census data.

6.4 Besides the census, a well-designed national agricultural statistical system includes surveys aimed at collecting more specific and timely information, for example, data on crop yields, prices, and production that is not feasible to collect through an agricultural census.

Sample design and survey design

6.5 The **sample design** of a survey or an agricultural census conducted by sample enumeration refers to the techniques for selecting a probability sample and the methods to obtain the estimates of the desired characteristics from the selected sample.

6.6 The **survey design** refers to the definitions and established methods and procedures concerning all phases needed for conducting the operation: the sample design, the selection and training of personnel, the organization of the logistics involved in the distribution and receipt of questionnaires, the data collection and data processing procedures, and the analysis of data needed for the release of the final results.

6.7 An agricultural census may have a number of different survey designs. For instance, it can be carried out using a number of different enumeration procedures (e.g., by personal field interview, by expert observation, self-administered questionnaires, by mail or, perhaps, by telephone), by complete or sample enumeration, different types of sampling units, sampling selection methods and estimation procedures, by including or not the identification and objective measurement of agricultural areas or other agricultural commodities in the selected enumeration units, etc.

6.8 In agricultural censuses, most data are obtained by enumerators through personal interviews with the holders by using a questionnaire for each holding. Indeed, in developing countries it is not generally feasible to use, on a large-scale, other data collection procedures, such as self-administered questionnaires, mail, or telephone.

Complete enumeration censuses versus censuses carried out on a sample basis

6.9 Agricultural censuses can be classified into two categories: censuses conducted by **complete enumeration** of all holdings or by a **sample enumeration**. The main characteristics of these two categories are the following:

6.9.1 **Complete enumeration.** For agricultural censuses conducted by complete enumeration (which are called simply agricultural censuses in many countries), the enumerators complete a questionnaire for each holding. The result for each characteristic is obtained from the values of the characteristics in all holdings. Therefore, the census results include only non-sampling errors.

6.9.2 **Sample enumeration.** Agricultural censuses based on sample enumeration are probability sample surveys, that is, surveys for which a probability sample (of *sampling units*) is selected, and for which the methods of estimation for each census characteristic allows establishing their statistical precision. This requires, in particular, defining the sampling units and their probability of selection, from a known universe (frame).

Advantages of carrying out a census on the basis of complete enumeration

6.10 The census results can be obtained for small administrative and other area units. Such information is sometimes required by law, for local planning, or for practical purposes such as irrigation projects or projects on regionalization or on an agro-climatic and ecological basis. (*Sampling methods cannot provide accurate information for small administrative subdivisions.*)

6.11 Some crops, although cultivated only to a limited extent, may be of great economic importance. Information on such crops can only be reliably obtained from a complete census. The situation is similar with regard to rare species of animals, or any other rare variable. (*Sampling methods cannot provide accurate information on variables that occur infrequently.*)

6.12 Current agricultural statistics in most of the countries have to be collected through annual sample surveys. These sample surveys can be planned much more efficiently if census results are available for small area units. First, the census listings can be used as a frame for the selection of the sample. This may prove an important saving because the preparation of the frame itself generally consumes a significant part of the budget allocation for the sample survey. Furthermore, census data can be used for improved sampling design and better estimation procedures, which may lead to more reliable estimates of the characteristics under study.

6.13 The planning and implementation of an agricultural census conducted on a complete enumeration basis requires fewer highly qualified statistical personnel than a census conducted on a sample basis. This constitutes an important advantage in countries with limited technical expertise.

6.14 Processing data from a complete enumeration is straightforward and does not involve the calculation of sampling errors or expansion factors and therefore requires less skills. (*Processing the data from a sample enumeration is technically more complicated.*)

Disadvantages of carrying out a census on the basis of complete enumeration

6.15 In a country with a large number of holdings, to conduct a census by complete enumeration is, in practice, more expensive and time consuming than a census conducted on a sample basis. This is a particularly important consideration in areas with poor communication and transport facilities. (*Sample enumerations are generally considerably less costly than a complete enumeration.*)

6.16 For a complete enumeration census, a very large number of enumerators and supervisors are required. Quite often candidates with the desired qualifications are not available in the required number so the standard has to be lowered with a consequent effect on the quality of data. (*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 can be expected to be much better because of the employment of better trained enumerators and supervisors and better quality control.*)

6.17 The quantity of data to be processed is very large for a complete census. The results may be considerably delayed if insufficient data processing equipment is available. The cost of processing the data will be higher due to the large volume to be processed. (*Sample enumerations require less processing capacity (fewer forms to process) and the results are usually available considerably faster than for a complete enumeration census.*)

Factors for consideration in choosing between a complete or a sample census

6.18 The sample enumeration is a very attractive proposition where there is a severe limitation of funds and personnel and the aim is confined to securing data with reasonable accuracy for major administrative units and the country as a whole.

6.19 A decision whether to carry out a complete enumeration or to plan a sample survey of holdings will depend on the level at which the results are required, that is whether the results will be tabulated for the entire country, for individual provinces, for individual districts or even for smaller administrative sub-divisions. In practice, this decision is either a complete enumeration or a sample enumeration but could be a combination of both.

6.20 Even those countries which lack resources in terms of funds and trained personnel should seriously consider the possibility of undertaking at least a minimum part of the census 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. Many countries adopt a phased approach to their agricultural census by conducting an initial listing exercise as the first stage to obtain a complete frame of all agricultural holdings in the country and collect some limited information on key variables. The second stage of the census is a sample enumeration to collect the required detailed information.

6.21 In practice, control of non-sampling errors, including those of non-response, may be possible only on the basis of a sample. Even though a census may have been planned on the basis of a complete count, sampling techniques will have to be used for controlling the census operations, the response errors and those of data processing. However, in order to carry out these tasks effectively there is a need for highly-qualified persons to design and execute the sampling plans.

Main types of sample designs for agricultural censuses

6.22 For agricultural censuses based on a sample enumeration, there are two basic types of sampling methods commonly used concerning the final stage sampling unit and their probability of selection, namely **list sample methods** and **area sample methods**. In addition, **multiple frame sample methods** are also used, these being survey designs that combine an area sample with a list sample to obtain the census estimates.

List sample designs

6.23 **List sample designs** are the most commonly used sampling procedures. In this case, the last-stage sampling units are generally the holdings or the holders' addresses.

6.24 List sample censuses often include some strata of special holdings that are completely enumerated, or have a high sampling-selection fraction. Such strata consist of holdings that either correspond to a significant proportion of the total estimated value of important census characteristics, or, if selected in the sample, whose characteristics may distort the results. For example, the strata of special holdings may consist of large holdings, holdings with the largest area for a given crop, with the largest livestock herds, highly specialized holdings or those corresponding to a localized production.

6.25 Cluster sampling is commonly used to account for geographic contiguity in the first stages of the sampling method. A sample of holders can be selected indirectly by first selecting a sample of villages (Primary Sampling Units-PSU's) with probability proportional to their total population (or housing units) since such information is usually available in most countries and approximates to the number of holders. Hopefully some additional information about the villages, such as farm population and primary agricultural activity, will also be available for at least rudimentary stratification. Other small administrative subdivisions, such as districts, counties or other administrative divisions could be used as well as villages as

PSU's. The total population of each selected village would then be screened for agricultural holders and a sample of holders selected in a second stage of sampling.

Data collection procedures for list sample designs

6.26 During data collection, the enumerator usually completes a questionnaire for each selected holding by conducting an interview with the holder. In addition, in some cases the enumerator measures the fields and gathers whatever other data is needed to complete the census questionnaire.

Area sample designs

6.27 An **area sample design** is a probability sample method in which the final stage sampling units are land areas called **segments**, and the selection probabilities are proportional to their area measurement (size). Therefore, the entire survey area is considered to be completely subdivided into non-overlapping segments that are the **sampling units**.

6.28 Most area sample survey designs for agricultural censuses consist of a stratified probability sample of segments. The strata are defined by intensity of cultivated land, predominance of certain crops or other land-use characteristics.

6.29 Two types of segments have been used for the area sample design of censuses in developing countries:

6.29.1 **Segments that have recognizable physical boundaries.** The boundaries of a segment are physical terrain features, such as roads, rivers, canals, railroads, etc., that are readily found and provide an unambiguous identification of the segment. In this case, for each stratum, the segments are defined with approximately equal size (area) and a constant sampling expansion factor is used to obtain the estimates derived from data in the segments. The sample usually consists of a number of selected independent sample replicates in each stratum, that facilitates the rotation of the sample to reduce respondent burden if the sample is to be used periodically over time. The sample design can be considered a stratified cluster sample of **tracts**, which are the parts of holdings (or non-agricultural areas) included in the segments.

6.29.2 **Segments that coincide with the land of the agricultural holdings (point sampling).** In this case, a grid is overlaid on the strata and a sample of points is selected. Then, the points are identified on the ground and the corresponding holdings form the area sample. Thus, the design can be considered a stratified sample of holdings selected with probability proportional to their areas (size).

Data collection procedures for area sample designs

6.30 Area sample designs with segments that have recognizable physical boundaries generally involve an annual (or seasonal) field data collection carried out by enumerators who complete a questionnaire for each tract included in each selected sample segment but can also be used in taking censuses. The data collection may involve objective measurement of agricultural areas utilizing aerial photo enlargements (or maps or scale drawings), called **segment photos**. For each tract of a given sample segment the enumerators delineate on the segment photo the boundaries of the tract included inside the

segment and the boundaries of all fields included in the tract, and verify the crops planted and other uses of land for each field, and also the information provided by the holder. Such identified agricultural areas in each sample segment are later measured in the office using a planimeter or a computer graphic system providing the basis, through sample expansion procedures, for an objective estimation of agricultural areas.

6.31 For the objective measurement of agricultural areas, the measurement on aerial photos is a very important advantage particularly if the interviewed holder does not know or does not want to report the area of land operated.

6.32 Area sample designs with segments that are the land of the holdings are generally enumerated by enumerators who complete a questionnaire for each selected holding. The data collection may not involve objective measurement of agricultural areas. If objective measurement of agricultural areas is required, this may be accomplished with list samples, namely by measuring the holdings and fields on the ground, without using aerial photos for measurement.

Estimation procedures in area sample designs with segments that have recognizable physical boundaries

6.33 Since sampling units are land areas (segments) that may not coincide with the land of a holding, it is necessary to establish a criterion to associate each segment 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. Then, a uniform expansion factor is applied in each stratum to obtain the census estimate for the characteristic.

6.34 For agricultural censuses based on an area sample with segments that have recognizable physical boundaries, two types of direct expansion methods have been used to associate segments with holdings and to expand the results obtained in the holdings associated with the selected sample of segments.

6.35 The direct expansion estimations refer to the way the holding data are distributed among the segments before they are expanded by the inverse of the sampling fraction. The direct expansion methods used are called the weighted segment method and the open segment method.

6.36 Ratio-estimation methods can also be used to improve the direct-expansion census estimates. However, except for direct-expansion methods, no other type of estimation procedures are covered in this outline.

The weighted segment estimation method

6.37 Let us consider a segment in a given stratum. The direct **weighted segment estimation method** involves the following steps:

- i) The weighted segment method uses all holdings with a tract in the segment, by associating to the segment all holdings with any land inside the segment.
- ii) The value of a given census characteristic in each tract (e.g., the number of cows) is defined as the value of the characteristic in the holding multiplied by a factor equal to the ratio between the area of the tract divided by the area of the holding. For instance, if 10% of a holding's area is in the tract, 10% of the total number of cows of the holding are assigned to the tract.
- iii) The value of the characteristic in the segment is defined as the sum of the characteristic in each of its tracts, as defined above.

- iv) The census estimate of the characteristic in the stratum is the sum of the characteristic in all its segments multiplied by the expansion factor of the stratum.
- v) Finally, the census estimate of the characteristic is the sum of the characteristic in all strata.

6.38 The weighted-segment estimator does not require establishing precisely who is the holder, the location of his residence or the holding headquarters, but it is obviously necessary to identify the holding, calculate its area inside the selected segments, and find an informant who can provide data for the total holding. The use of the weighted segment estimator is the recommended estimator for censuses based on area sample designs.

The open segment estimation method

6.39 The direct **open segment estimation method** involves the following steps:

- i) The open-segment method associates to the segment all holdings with headquarters inside the segment. For this purpose, clear rules have to be established to define a unique reference point for each holding, called the **headquarters**. There are several ways to do this but the most common procedure is to define the headquarters as the dwelling (residence) of the holder. In this case, a one-to-one correspondence between holdings and headquarters can be established, with an additive rule in case of joint holders living in different dwellings.
- ii) The value of the characteristic in the segment is defined as the sum of the characteristic in each of its associated holdings, i.e., the holdings with headquarters inside the segment.
- iii) The census estimate of the characteristic in the stratum is the sum of the characteristic in all its segments multiplied by the expansion factor of the stratum.
- iv) The census estimate of the characteristic is the sum of the characteristic in all strata.

6.40 Open segment estimators are not generally recommended due to the difficulty that arises in identifying (creating a one-to-one correspondence between holdings and headquarters) and locating the residence of the holders in urban areas.

Multiple frame sample designs

6.41 A survey design that combines an area sample design with a list sample design, is called a **multiple frame sample design**. Multiple frame estimates combine area sample with list sample estimates for each census characteristic. The results obtained from the list sample are expanded and added to the area sample estimate.

6.42 The list sample component of a multiple frame design is called the **list of special holdings**, and is usually formed by those holdings with the largest total area and the largest area for a given crop, those with the largest number of livestock and poultry, those with the largest revenues, with the largest number of agricultural workers, highly specialized holdings and those corresponding to a localized production. The list of special holdings should all be enumerated if possible. In this case, the results obtained from the list are added to the area sample estimate with no contribution to the overall variance.

6.43 A list sample is a necessary addition to an area sample in order to provide adequate estimates for important agricultural characteristics. In fact, as already mentioned for list

samples, many important agricultural characteristics have a skew distribution, concentrating a significant proportion of the total estimate in a small proportion of the holdings. For some of those characteristics, the list sample component (the list of special holdings) should account for the skewness of their distribution so that the multiple frame estimates will be significantly more precise than the area sample estimates.

6.44 For multiple frame designs, any duplication between the list 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 particularly important in developing countries to utilize a relatively short list of special holdings, that would be feasible to inspect.

Choice of sample design

6.45 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. The choice of survey design should be made taking into account the trained personnel, the resources available and the desired accuracy of estimates of the principal characteristics. The sample design should also be simple enough to operate in the field with the help of available personnel. Experience indicates that it is difficult to make adjustments for any significant deviations occurring from the sample design (missing questionnaires, errors in selection of the sample, errors in the frame, etc.) if the sample design is not simple. Also, the size of the sample has to be fixed at an adequate level so that it can be enumerated within the time limit prescribed for the statistical operations. The total cost and requirements of personnel (the number and the period), the construction of the frames and the other required facilities should be clearly assessed and definite government approval obtained for incurring the expenditure. In case funds and other resources required are beyond the capacity of the country, the sample designs have to be adjusted keeping in view the resources actually available and the authorities have to be informed of the type of results that will be achieved with this change in the sample design. It may also be said that resources promised 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 somewhat less than promised. 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 ingenuity on the part of the statistician, a periodic review of the resources and an intimate knowledge of how the census operations are proceeding. Of course, once the original design has been carefully chosen, it should not be abandoned or modified except for serious reasons.

6.46 The **sample size** in a given situation is difficult to determine. The appropriate sample size depends upon many factors, such as the efficiency of the sampling design adopted and the number of areas and classifications for which estimates are required. If the data are needed for planning at administrative sub-division level, a much larger sample will be needed; a sampling fraction of 2 to 10 percent of the holdings may be adequate for providing reliable estimates for all the principal characteristics. However, if such information is needed at only the broad provincial level or national, a sampling fraction of 1 to 2 percent of holdings or agricultural areas may do. 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 at the time of the pilot census. One of the objectives of the pilot census should be

to study the variability of different characteristics and the time and cost involved in obtaining information on them.

6.47 For an agricultural census to be conducted by sample enumeration, the sample design should be chosen by considering the characteristics of multiple-frame methods and list sample methods along with their comparative advantages, disadvantages and requirements.

6.48 Comparisons of the different types of sample survey designs require special statistical knowledge that is beyond the scope of this publication; the reader could usefully refer to the publication *Multiple frame Agricultural Surveys- Agricultural Surveys based on Area and List Sampling Methods*, FAO (1995). Nevertheless, a few simple indications will be given in the sequel to illustrate the factors to be considered when choosing an appropriate sample design for an agricultural census. For such purpose, a few definitions and specifications are given below.

6.49 A sample frame will denote here, as is usual in survey sampling texts, the total set of sampling units, that is, the set of units from which the sample is selected. Accordingly, a list frame is a list of all holdings and an area frame a list of all segments (land areas) of the country (see Chapter 7).

Multiple frame designs versus area sample designs

6.50 Multiple frame designs that combine an area sample with (at least) a short 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 for its design and implementation will generally not be significant.

Multiple frame designs versus list sample designs

6.51 When further 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.

6.52 For an agricultural census to be conducted by sample enumeration, the following preliminary considerations can be used to compare the different types of sample designs:

6.52.1 **Unbiased estimates.** An area sample can generate unbiased estimates since it is based on a sample from a frame that provides complete coverage of the area of interest. This cannot be said for a census based on a list sample since, in practice, a complete and perfectly updated list of holdings, valid during the data collection period, cannot be established: list frames of holdings are often incomplete and outdated. Coverage errors are a major problem in list sampling, but not in area sampling provided the rules of association linking holdings with selected segments are performed correctly.

6.52.2 **Precision of the estimates.** The multiple frame method, which combines an area sample of segments with recognizable physical boundaries, obtains more precise estimates of agricultural areas, a key variable studied in all agricultural censuses, than a list sample. In fact, by definition, in area sampling the probabilities of selection and the sampling expansion factors utilized are precisely proportional to agricultural areas. This is true for an area sample design of the type considered in which the main crop areas in the selected segments are identified and delineated on aerial photographs

or detailed maps during the field data collection and then *measured* in the office. In other words, a multiple frame design involves objective measurements of agricultural areas, which is an important advantage for providing precise area estimates.

6.52.3 **Non-sampling errors and objective measurement of areas.** In area sample designs in which segments have recognizable physical boundaries, non-sampling errors associated with area measurements are reduced by using aerial photographs of the selected segments that clearly indicate the holdings and the fields. The photographs are used to check reported area of fields and total area of the holding itself. The holder is more inclined to be truthful when confronted with questions about specific portions of his holding that are also being observed by the enumerator at that moment. Such area sample designs provide more precise estimates than list sample designs. Many list sample methods do not require measurement of areas but rely on respondent information. For list sample designs that require measurement of areas, the measurement is usually done only in a subsample of holdings during the field data collection. These procedures are generally very slow and somewhat cumbersome to apply, and are impractical for measuring holdings formed by parcels located a long distance from one another. It should be mentioned that in many countries, or in large areas of developing countries, the areas reported by holders are not considered reliable and therefore objective measurements of areas are required to obtain reliable estimates. This need arises partly on account of all kinds of arbitrary local units of measurements in use in different parts of the same country, and partly because of the general tendency among holders to under report their areas and production.

6.52.4 **Unbiased annual estimates.** If an annual agricultural survey is to be implemented using the census sample design, it is worth noting that the area frame is generally far more durable than a list frame of holdings. An area frame can be used over a period of years (say 5-10) without updating the sampling units in areas where agriculture is stable. An area frame does not become outdated unless the population extends into areas not covered by the frame. Changes in land use, or in the number and location of holdings, may reduce the precision of the estimates but they do not introduce bias.

6.52.5 **Basis for a crop cutting yield survey.** An area sample with segments that have recognizable physical boundaries provides the means for selecting a statistical sample of fields needed to conduct crop cutting yield surveys and therefore for estimating crop production when crops mature and forecasting crop yield estimates by measuring plant characteristics at certain stages of growth during the crop year. In other words, an area sample provides the means to better estimate crop yields.

In developing countries, holders are often not able to report reliable estimates of crop yield and production and there is the problem of local measures which often vary from village to village or even from holder to holder. Crop-cutting techniques are recommended to collect objective estimates of yield. Crop-cutting methods for estimation of crop yield have been adopted by many developing countries as a standard technique. From the sampled fields a standardized plot, usually in the form of a square or a circle, is taken for measuring the yield of a given crop. In the case of rice and wheat, a plot of 1 to 5 sq.m. could be sufficient. For maize and tubers 10 to 25 sq.m.

plots are preferred while for widely spaced crops 100 sq.m. may be more adequate. For obtaining reliable estimates of yield at district or administrative sub-division level, at least 100 to 200 crop cuttings should be made. The crop-cutting method is very time consuming and expensive. Furthermore, it is subject to various biases, such as border bias as yield is different at the borders than inside the field. Other biases arise because of inadequate training of enumerators or because of inadequate supervision. Countries should, therefore, find which method will best suit their conditions and also consider organizing special studies for evaluating local measuring units in order to improve production estimates provided by holders.

- 6.52.6 **Complexity of implementation.** The implementation of an area sample design with segments that have recognizable physical boundaries requires more technical expertise than the implementation of a list sample design.
- 6.52.7 **Cartographic requirements.** The selection of an area sample requires accurate cartography 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. Aerial photos of the selected segments are a great advantage if objective measurement of areas is required.
- 6.52.8 **Proximity of the holder or respondent to the holding.** It may not be feasible or even possible to use an 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 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.
- 6.52.9 **Costs.** There are high costs involved in the selection of an area sample of segments with recognizable physical boundaries, and these costs may be higher than those needed for the selection of a list sample. However, such a high investment may easily be justified if the samples are to be used on a regular survey basis.
- 6.52.10 **Lack of permanent boundaries.** For an area sample design with segments that have recognizable physical boundaries, the lack of permanent boundaries in the maps, satellite images and aerial photos constitutes a serious problem. In tropical areas, such as West Africa, because of the climatic conditions and shifting cultivation systems, boundaries change more frequently or get covered by bush and are not visible on the cartographic materials.
- 6.52.11 **Distinguishing characteristics.** A distinguishing characteristic of multiple frame sample designs is that they have incorporated important technological advances in computer data processing to a larger extent than list sample methods. In fact, area sample methods can utilize satellite imagery or even digital satellite data as part of Geographic Information Systems, hand-held Geographic Positioning Systems and generally a variety of automated procedures and techniques for sample selection and data analysis.

Other uses of sampling techniques

6.53 Besides conducting field data collection on a sample basis, there are many other ways and reasons to use sampling techniques for completing the work of an agricultural census. Some of the most important and indispensable applications of sampling techniques for an agricultural census are listed below:

- (i) Arranging collection of data in two parts: a simple questionnaire by a less qualified set of enumerators on a complete enumeration basis, and a more complex questionnaire by enumerators of higher qualifications on a sampling basis.
- (ii) Combining a complete enumeration of large holdings with a sample enumeration of small holdings.
- (iii) Checking the completeness of a frame of holdings or households especially when the frame available is rather old (see Chapter 7).
- (iv) Pre-test surveys and pilot censuses for checking the questionnaires and various census procedures (see Chapter 13).
- (v) Arranging supervision of field work on a rational basis with a view to providing a measure of the quality of data collected, and to provide for a correction factor wherever possible.
- (vi) Arranging the field work in a set of replicate samples such that each is capable of providing valid estimates of characteristics under study so that these estimates observed together provide a measure of the reliability of the census data.
- (vii) Designing supplementary sample surveys covering special subjects, such as crop-yield objective measurements, livestock and poultry in urban areas not covered by the census, smallholdings below size covered by the census.
- (viii) Post-enumeration surveys on the completeness of data collected and evaluation of response errors (see Chapter 16).
- (ix) Rapid preparation of some preliminary results of the census.
- (x) Quality control of errors in the data processing: coding, verification of data entered, etc.
- (xi) Final tabulation of the data on the basis of a sample as an emergency solution, in situations where resources are not sufficient for carrying out the analysis of all the data collected.

6.54 The approach where sampling is used together with complete enumeration for increasing the scope of the census by augmenting, with the help of a sample, the information collected through complete enumeration, may be particularly suitable (see ii) above). This means that for basic items in the agricultural census, complete enumeration of all holdings is undertaken, but for various additional items only a sample of holdings is enumerated. These additional items are usually of a more complicated character and involve careful questioning of the respondents. A more qualified type of enumerator is required and can be entrusted with this work if it is limited to a sample of holdings. Normally, a single sample would be selected for whatever additional information is sought, but it may also be distributed over different samples, a limited amount of information being collected from each sample, so that all samples put together provide the total additional information proposed to be secured by sampling without placing an unduly heavy burden on the respondents. This operation of securing additional information from a sample can either be done simultaneously with complete enumeration or be staggered so that supervisory staff can be employed for enumerating the sample, after they become free from the supervision of the main census.

Suggested reading

- Ardilly, P. (1994). Les techniques de sondages. Technip.
- Cochran, W.G. (1977). Sampling Techniques. Third edition, John Wiley and Sons.
- Cotter, J. and Nealon, J. (1987). Area Frame Design for Agricultural Surveys. National Agricultural Statistics Service, USDA, Washington.
- Desabie, J. (1966). Theorie et pratiques des sondages, Dunod.
- Dubois, J.L. et Blaizeau, D. (1989). Connaître les conditions de vie des ménages dans les pays en développement. Ministère de la coopération et du développement, France (3 volumes).
- FAO (1989)-Kish, L. Sampling Methods for Agricultural Surveys. FAO Statistical Development Series No. 3, Rome.
- FAO (1995). Multiple Frame Agricultural Surveys-Agricultural Surveys based on Area and List Sampling Methods. FAO Statistical Development Series No. 7, Rome.
- Hansen, M. H., Hurwitz, W.N. and Madow, W.G (1953). Sample Survey Methods and Theory. Vols. I-II, New York: John Wiley and Sons.
- Houseman, E.E. (1975). Area Frame Sampling in Agriculture . Statistical Reporting Service, SRS No. 20, USDA, Washington.
- Kish, L. (1965). Survey Sampling. John Wiley and Sons.
- Vogel, F.A. (1986). Sample Design and Estimation for Agricultural Sample Surveys. Statistical Reporting Service, NASS/USDA, Washington.

CHAPTER 7

PREPARATION OF THE FRAMES

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 and surveys.

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.

Definition of frame

7.1 The sample design of an agricultural census may have one or more sampling selection stages. As defined in survey sampling texts, and already mentioned in Chapter 6, the sampling frame for a given sampling selection stage is the set of sampling units from which the sample is selected, together with their probabilities of selection. Since the census characteristics or items that one wishes to study are defined in the holdings, if the sampling units are *not* the holdings, rules should be established to give a value of the characteristics in each sampling unit as a function of its values in a group of associated holdings.

7.2 A **list frame** is a frame used for the last selection stage of a list sample design. List frames are formed by lists of holdings or holders' addresses. In particular, the frame of a census conducted by complete enumeration (100% sampling) is the list of all holdings or holders addresses in the country.

7.3 An **area frame** is a list of all segments (land areas) of the country used for the last stage of selection of an area sample design.

7.4 A **multiple frame** design is a combination of the above two.

Practical approaches of frames

7.5 A sampling frame, as defined above, most often does not exist in practice. For example, a complete list of all holdings in the country is never available before conducting a complete enumeration census. Therefore, in practical applications, to be able to enumerate all holdings a preliminary frame is indispensable. In applied survey sampling, for convenience such preliminary frames are simply called frames. Therefore, a frame for each sampling stage of an agricultural survey design is a set of physical materials (maps, census statistics, lists, directories, records) that cover all holdings and allow for providing suitable sampling units. From now on, this will be the definition of the frame adopted.

7.6 A prerequisite for the organization of an agricultural census, whether conducted by complete or sample enumeration, is the preparation of suitable frames.

7.7 In developing countries it is advantageous to use the opportunity of conducting an agricultural census to prepare an efficient sampling frame which can be utilized not only for the census but also for subsequent annual or seasonal agricultural surveys, thus improving the agricultural statistical system.

7.8 The preparation of a frame for an agricultural census conducted by complete enumeration of all holdings, and similarly the preparation of the frames for an agricultural census conducted by sample enumeration, requires a large proportion of the total effort, time and resources invested in a census programme.

The frame of a census conducted by complete enumeration

7.9 In order to conduct an agricultural census by complete enumeration of all holdings, 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 **enumeration areas (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.

7.10 More precisely, the agricultural census EAs are geographic areas such that:

- (i) They constitute a complete subdivision of the land, with no overlapping, covering all holders' housing units;
- (ii) 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;
- (iii) 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
- (iv) Their area should correspond to approximately equivalent workloads weighting:
 - the approximate number of holders' households;
 - the distances and difficulties of access to the holders' dwellings;
 - the average time needed for each interview and the established length of the census enumeration period.

7.11 An **agricultural census frame** is a list of enumeration areas, with the estimated number of holdings in each enumeration area.

7.12 The EAs often are the smallest subdivisions of the country for which agricultural census data will be available.

7.13 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 enumeration area. 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. 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 for those of an agricultural census.

7.14 The possible sources of available information for the construction of an agricultural census frame are the following:

- (i) The statistical data and maps of the EAs of the latest agricultural census including a list of EAs with their number of holdings.
- (ii) 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;
- (iii) Listings with the addresses of holdings not directly associated with holders dwellings;
- (iv) Registers, surveys, cadastral and other cartographic materials, which include listings of holdings or holders' addresses or their approximate location;

7.15 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 either entirely or partially useless 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.

7.16 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. 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 should not constitute the sole source of information for the preparation of an agricultural census frame.

7.17 The listings and cartographic materials indicated in item (iv) above are generally useful in preparing or verifying only a small proportion of an agricultural census frame. In fact, such listings and maps are usually less complete than those available from the censuses of population or agriculture. To a large extent, therefore, 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.

7.18 In a number of developing countries it might be necessary, due to lack of reliable information, to prepare the census frame by conducting a preparatory survey. And, it might even be necessary, due to lack of good maps, to prepare sketches for the EAs.

7.19 It is preferable that the EA be small in size, say less than 50 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 except in cases of extreme carelessness.

7.20 If large EAs are used, including in some countries as many as 500 holdings or more, spread over several square kilometres, 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, 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. However, in rural areas the houses are not usually arranged in blocks, nor do well-defined streets with names and house numbers exist. 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.

Construction of the frame using the population and housing census

7.21 National population and housing census data and maps can be used in various ways to construct a frame for the agricultural census. 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.

7.22 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.

7.23 The use of the population census to prepare the frame of an agricultural census is particularly useful in countries where most of the agriculture is covered by the rural households.

7.24 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.

7.25 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.

7.26 In urban areas where the proportion of 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.

7.27 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.

7.28 Population census questionnaires, in most cases, do not allow a direct link to be established between agricultural holdings and households. However, the population census questionnaires generally identify the population whose main activity is agriculture within the context of a fairly short time-reference period.

7.29 If a population census is to be conducted shortly before an agricultural census, consideration should be given to the following aspects of the population census questionnaires:

- (i) The inclusion of questions aimed at identifying agricultural holders' households, such as obtaining the main and secondary occupation of the population during the agricultural year, questions which allow distinguishing between work performed on the respondent's holding and work performed on other holdings.
- (ii) The inclusion of questions designed to provide information on basic characteristics of agricultural holdings.

7.30 Modifying the population census questionnaires for the purpose of undertaking an agricultural census shortly thereafter requires careful consideration. The disadvantages are the additional complexities and costs involved in several areas of the census programme, such as the training and selection of enumerators and the census field data collection. It should also be kept in mind that such changes would produce useful additional data for a small proportion of households - namely agricultural holders' households - while producing lower quality data for the majority of the population.

7.31 An alternative to conducting the agricultural census shortly after the population census would be to conduct both censuses simultaneously, as is done in some countries, particularly in Latin America and the Middle East. There are advantages to such an approach. The listing of households and agricultural holdings addresses can be done in one operation. The same mapping material and the same field staff can be used providing there is timely and adequate planning. Furthermore, coordination of actual collection of data of interest to both censuses, such as demographic data and data on employment in agriculture, is possible. This coordination may be achieved either in the data collection phase, or by matching related computer records in the data processing phase of both censuses. In practice, it appears that this joint approach may be applicable in countries where the same office, such as the Central Statistical Office, is responsible for both censuses. Otherwise, the coordination of the two operations becomes very difficult.

7.32 It is feasible to design the population census EAs, and in some cases to adapt the census questionnaires, to construct adequate frames for censuses and list frame sample surveys of agriculture. However, the specific concepts involved in an agricultural census are much different from those of a population census, and require enumerators with specific knowledge of agriculture. Also, as these two types of censuses are not always the

responsibility of the same national organization practical difficulties have arisen in attempting to apply the population and housing census to the construction of an agricultural census frame.

7.33 It is extremely important 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 may be to closely link it to the population census.

7.34 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.

7.35 Population and housing census data, enumeration districts and maps often provide a highly important component in constructing the agricultural census frame or the list frames of a sample survey. In addition, in most cases the population census information is the best tool for detecting inconsistencies in and verifying the validity of agricultural census frames.

The frame of a census conducted by sample enumeration

7.36 In order to conduct a census by sample enumeration, as mentioned in Chapter 6, there are two basic types of sample designs concerning the final stage sampling units and their probabilities of selection, namely, **list sample designs** and **area sample designs**. 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.

Preparation of the frames for list sample designs

7.37 **List sampling frames** of holdings or holders' addresses come from previous agricultural, housing or population censuses, from an accumulation of lists prepared by political or administrative subdivisions, farmer's associations, tax records or other sources. There is usually information on population and housing units, availability of markets, schools, drinking water, electricity, health assistance etc., and possibly information on holdings size, crops grown, and livestock for each holding that allows them to be classified into groups with similar characteristics (strata) which greatly improves sampling efficiency. Some of this information may be used for checking the internal consistency of the census results.

7.38 The frame for the last stage of selection is generally constructed from new listings obtained by direct field enumeration of holdings or holders' households.

7.39 For the implementation of list sample designs good maps are even more important than for complete enumeration censuses because there is a high risk of double counting or omitting from the frame some agricultural holdings. In a census conducted by complete enumeration, a holder interviewed twice will inform the second enumerator about this fact, so that corrective action can be taken. It is important to note that for the implementation of list sample designs detailed maps are needed only for areas included in the sample.

7.40 There are many different ways of preparing a list of agricultural holdings. Local knowledge should be used to list not only farm households but also holdings under different legal status, such as cooperatives, government farms, enterprises, etc.

7.41 In the case of countries or areas which maintain up-to-date land records (a cadastre), it may be easy to prepare a frame through reference to the land records. In the land records the name of the holder is normally entered against each of the fields operated by him. By looking into the land records, it may be possible to sort out the list of all the holders of a given area or village. Checking the internal consistency of the cadastre is essential. By covering each and every field of the given area, it should be possible to completely list the holders. The procedure has several shortcomings. Firstly, the holder staying in that area but operating elsewhere may not be listed. Secondly, those who do not operate land but are engaged in poultry or dairy farming may be omitted. Thirdly, the cadastre often records names of owners rather than names of holders.

7.42 In some countries where rural reconstruction and development programmes have been initiated, a list of households may be readily available and this can be used to screen the farm households. In case the land tax is paid by the holder, it will be necessary to maintain a list of holders which can serve as a useful frame to start with. In India, in some states a list of actual holders of land is maintained by the village officials for many development activities. Such a list may be a good starting point for the preparation of the list of holdings. Such a list, however, does not include those who do not cultivate any land but are engaged in livestock or poultry production.

7.43 In case no list of households or holdings is found, it will be necessary to prepare a new listing of households operating some land or keeping some livestock or doing both. The enumerator may be instructed to start from a fixed point of the village/enumeration block and systematically number serially each of the houses in the enumeration block. This will ensure that no house has been left out. In each house there may be more than one holding. Only some of the members of the household may be agricultural holders. The enumerator should proceed from house to house, listing households along with the information whether or not its members are holders. Although in the agricultural census the enumerator is concerned only with the list of the agricultural holders, it will be desirable to prepare the list of all members of the households for the sake of completeness and internal checking. Later, when the actual data relating to the agricultural census are to be collected the inquiry may be confined only to those household members eligible as agricultural holders. Sometimes, a holder may operate more than one holding. For example, the holder may operate some land with the help of the members of his own household and some other land jointly with the members of other households. According to the agricultural census concept, there will be two holdings in this case, one individual holding and the other a joint holding. In the preparation of the frame, such situations should be covered and there should be provisions for listing such holdings.

7.44 For an annual or seasonal agricultural survey, a list frame of holdings or holders addresses prepared for the census is often incomplete or inaccurate, contains an unknown amount of duplication, and is rapidly outdated. If the list is a few years old, many of the names will no longer represent a holding due to sales, deaths, and abandonment, and also new holdings are not represented. It is also common in list building to unintentionally include more than one name that could be associated with a specific holding. In short, it can be seen that it is difficult for a list of holding addresses to fulfil the requirements for an adequate periodic agricultural survey frame, particularly if it is a large list. To be truly effective, a large list must be continuously and systematically updated which is expensive, time-consuming and requires a large staff. When the list frame is inaccurate the sample

cannot be assumed to be a probability sample and the survey should be considered a subjective survey.

7.45 As mentioned in Chapter 6, list sample censuses often include some strata of special holdings that are completely enumerated, or with a high sampling selection fraction. The strata of special holdings may consist of large holdings, holdings with the largest area for a given crop, with the largest livestock herds, highly specialized holdings or those corresponding to a very local area of production. Such lists of special holdings are fairly easy to update since the holdings involved are usually visible and well known. Information can be obtained from extension agents, producers' associations, banks, tax records, agricultural censuses and from government agencies that either control and/or purchase production of certain crops. The preparation of such lists should include the accumulation of data on each operation such as holding size, crops grown, type of livestock and inventory, etc. for stratification purposes if the list is to be sampled.

7.46 The use of the census EAs from a population census or the use of the census EAs from the latest agricultural census as Primary Sampling Units (PSUs) is a usual form of cluster sampling for list sample agricultural surveys. It should be noted that although the PSUs are geographic areas, the associated probabilities for the sample selection are not proportional to their areas: 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.

7.47 The average size of PSUs varies, in general, from 50 to over 200 holdings, of which 4 to 10 (at times even 30) are selected for the final sample.

7.48 Some of the problems involved in the use of list samples are the following:

- (i) In comparison with other sampling designs, a larger sample may be necessary due to the between cluster and within cluster variances.
- (ii) It is often not easy (sometimes impossible) to establish the boundaries of the PSUs whether they are villages, enumeration areas or administrative subdivisions.

Preparation of the frames for area sample designs

7.49 As defined in Chapter 6, an **area sample design** is a sample design in which the final stage sampling units are land areas called **segments**, and the selection probabilities are proportional to their area measures (size). Most area sample designs of agricultural censuses consist of a stratified probability sample of segments. The segments in each stratum are considered to be of equal size and selected with equal probability, and the estimation formulas used correspond to a single-stage design. The strata are defined by intensity of cultivated land, predominance of certain crops, special agricultural practices, average size of cultivated fields, agro-urban areas, or other land-use characteristics.

7.50 Two types of **segments** have been used for the area sample design of agricultural censuses in developing countries:

- (i) Segments that have recognizable physical boundaries.
- (ii) Segments that coincide with the land of agricultural holdings.

Preparation of the frames for area sample designs with segments that have recognizable physical boundaries

7.51 An **area sampling frame** is an ordered list of land areas, called **frame units**, with their assigned number of segments, such that:

- (i) The frame units form a complete subdivision of the total land area of each land-use stratum, with no overlap.
- (ii) The frame units provide a clear-cut means of identifying each segment.
- (iii) The number of segments assigned to each frame unit facilitates the probability sampling of segments.

7.52 A **frame unit** is an area of land with readily visible physical terrain features that contains a number of segments. All the land in an area frame is divided into frame units, without any overlap or omission. They are units that provide a means of identifying and counting segments without actually drawing off each segment. For identifying a selected segment it is only necessary to partition the corresponding frame unit into a number of segments equal to its assigned number of segments.

7.53 The frame units are subdivisions of the strata and preferably also administrative subdivisions of a province or even sub-divisions or aggregation of contiguous census EAs if they were defined with recognizable physical boundaries. This would allow for additional agricultural or demographic information to be used.

7.54 For the area sample designs described in this section, each stratum has a different target segment size from the other strata. Small segments usually correspond to strata of intensely cultivated land or to segments in the urban or agro-urban stratum.

7.55 The target segment size in a given stratum is generally set so that it is equal, on the average, to a day's work of an enumerator. An acceptable segment size in a stratum of intensely cultivated land is one quarter of a square kilometre (25 hectares). Segments may have 10 to 15 tracts.

7.56 Assuming that an area frame has been constructed for a province, an area sample size may be 400 segments. The target size of frame units (say 4 to 10 segments) is set based on the target segment size for the stratum (say 25 hectares) and the availability of good boundaries.

7.57 The preparation of an area sampling frame, in order to select a sample of segments that have recognizable physical boundaries is a very demanding task. To prepare an area frame, the first requirement is to have up-to-date cartographic material (maps, satellite images, aerial photos) on which the land to be included can be visualized. The resolution or detail of the material must be sufficient to allow stratification according to intensity of land use (proportion of land cultivated, predominance of certain crops or other uses of land, etc.) and the subsequent subdivision of these land-use strata into frame units also with recognizable physical boundaries. Land-use strata and frame units are identified on satellite images or a mosaic of aerial photography and then transferred to topographic charts and measured. There might be from 6 to 10 land-use strata in a province. Frame units are constructed generally with maps on which the boundaries of the land-use strata have been transferred. In each land-use stratum, each frame unit will have to be measured and assigned a target number of segments of equal size. The number of segments assigned to each frame unit are summed to provide the total number of segments in the stratum. Then a sample of segments is selected from each land-use stratum using a systematic or random replicated selection procedure, all segments having the same probability of

selection. Each sample segment is constructed on small mosaics of aerial photography on which the boundary of the corresponding frame unit have been transferred. The selected sample segments are located on appropriate aerial photo enlargements used to control field data collection.

Preparation of the frames for area sample designs with segments that coincide with the land of agricultural holdings

7.58 In this case, a grid is overlaid on the strata and a sample of points is selected. Then, the points are identified on the ground and the corresponding holdings form the area sample. Thus, the design can be considered a stratified sample of holdings selected with probability proportional to their areas.

Preparation of the frames for multiple frame sample designs

7.59 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.

7.60 The list frame component of a multiple frame survey can be a *large*, nation-wide list of holdings requiring a heavy investment in computer hardware and software a very controlled field operation for its periodic updating (if the frame is used periodically), and involving great difficulties for its combined use with the area sample. This type of multiple frame surveys, although the most accurate, is generally not adequate for developing countries.

7.61 The case of a relatively short complementary list frame, enumerated completely, used with an area sample is the multiple frame survey design described in the FAO manual on multiple frame agricultural surveys since these are generally the most adequate multiple-frame methods applicable in developing countries.

Geographic Information Systems (GIS)

7.62 Geographic Information Systems (GIS) can be defined as a set of application software, working on specific hardware, for collecting, storing, retrieving and displaying spatial data. GIS are used in many countries for a variety of purposes related to agricultural statistics. A GIS called CASS (Computer-Aided Stratification and Sampling) is currently used in the United States for area frame construction and sample selection. These procedures are highly automated and the material needs, mainly maps, are difficult to meet in most countries. The methods are important because they are adopted at present in the largest and oldest area frame project in the world and because they may represent the trend of the evolution of area frame construction and sample selection from manual to computerized procedures. In other words, these computerized methods may be partially or totally adapted to different conditions and requirements in other countries.

Suggested reading

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.

CHAPTER 8

CENSUS QUESTIONNAIRE

The census questionnaire is considered to be the basic census document, and is of key importance to the success of the census. This chapter discusses factors to be taken into account when preparing the questionnaire such as: size of the questionnaire, ability of agricultural holders to provide information required, kinds of questions, electronic processing of the questionnaire, etc.

Other primary topics closely related to questionnaire formulation are pre-test surveys and pilot censuses, which can test the questionnaire in the field (Chapter 13) and the Tabulation Plan (Chapter 9). The questionnaire is the means of collecting data required for the proposed tabulation plan. It is generally considered, that the tabulation plan should be developed before the questionnaire.

No examples of a census questionnaire are included in this chapter. Readers involved in questionnaire formulation are advised to find examples of questionnaires from previous censuses, other agricultural surveys, or from neighbouring countries. No suggestions have been made, regarding specific data items to be included in the questionnaire, as this subject is covered in the FAO document "Programme for the World Census of Agriculture 2000".

Development of the census questionnaire

8.1 Once the decision on the scope and coverage of the census has been taken, a questionnaire can be developed in order to secure the relevant information in an orderly and coordinated 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.

8.2 Generally three methods, (i) self-enumeration, (ii) interview method and (iii) objective measurements, are considered for obtaining census data. In a number of developed countries where the holder is literate and maintains records, or in the case of modern holdings/plantations in developing countries, self-enumeration is the preferred approach. For example, in the U.S.A. census data are obtained mainly through the mail-out/mail-back method. This consists of mailing the questionnaire to holders with several mail or telephone follow-ups when necessary, and, as a last resort, a personal visit of enumerators. Alternatively, self-enumeration may be organized by enumerators who visit holdings twice, first to leave the questionnaire and provide instructions, and second to review and collect the completed questionnaires with the possibility of transforming the second visit into an interview when necessary. In developing countries, where many holders are illiterate the interview method is necessary. Objective measurements of areas and yield are used in countries where holders are not familiar with standard units of measurement and where cadastre information does not exist.

8.3 Questionnaire, form or schedule are generally synonymous in statistical literature. Whether any distinction is made or not, the format of the questionnaire will depend on the

method of inquiry, whether by interview, by self-enumeration, intended for objective measurement or a combination of these methods.

8.4 The size and form of the questionnaire are the first items to be considered. The questionnaire should not be too large and should be easy to handle in the field. Its size and shape should be such that the enumerator can easily handle it in the field while recording the respondents' answers.

8.5 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 the mail. However, this argument is not valid for many reasons. Frequently the data requested is 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. It is, therefore, very important that the questionnaire is not too lengthy. 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.

8.6 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. An endeavour should be made to follow the recommendations of international programmes, for purposes of data comparison at regional and global levels.

8.7 Census data collection should normally be limited to structural items which do not change quickly over time, while more detailed information should be collected through specialized surveys subsequent to the census.

8.8 If it is observed that the questionnaire is too lengthy after carefully studying the subjects to be included and the corresponding questions, various possibilities may be considered.

8.9 One possibility is to distribute the questions in two or more questionnaires. It is almost certain that on smallholdings agricultural machinery is not used, nor are labourers hired for farm work, nor is there an irrigation system, so these items could be included in another questionnaire. 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 widen the scope of the census, the first questionnaire applying to all the holdings and the others relating to only specialized items like vineyards, greenhouses, nurseries, etc., in a complete enumeration or to a sample of them. In addition, when considering the subjects which need more in-depth study, the reliability of the sample results has to be taken into account when deciding what questions are going to be included in each questionnaire.

8.10 Another possibility is to use different questionnaires for different provinces when these differ considerably in crop and cropping practices. In this case various 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. This may, however, involve printing a different set of questionnaires to meet the requirements of different provinces.

8.11 Once the decision on what subjects 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 and enough space left between them so that they are distinct and can be easily located.

8.12 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.

8.13 At times it is advisable for a smooth transition between subject matter 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 not to lose the informant. 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. Furthermore, such introductory questions may be very useful in the data entry stage and are discussed later in this chapter.

8.14 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 tabulation of the data.

8.15 Another aspect to be considered is the colour of the paper. When an agricultural census is taken at the same time as a population census, it is very useful if different colours are used for the two sets of questionnaires, so that they can be easily distinguished and errors avoided in handling the census papers. The same reasoning applies when two types of questionnaire are used for collecting information, one of which will be answered only by a sample of holders. In general, since a large quantity of questionnaires are handled in a census, it is advisable to use different colours for each different questionnaire. Light colours which do not strain the eyes and on which it is easy to read should be chosen. Colours should change for each census so that questionnaires from different censuses can be easily distinguished if used during editing and processing.

8.16 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. Often, census offices, in order to keep questionnaires to a reasonable size, use a small print which is unacceptable.

8.17 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.

8.18 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.

8.19 The questionnaire must be uniform in style, that is to say the readings should all be printed with the same type of lettering, 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.

8.20 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.

Census questionnaire working group

8.21 Bearing in mind that the information obtained in the census will be used for the country's agricultural planning, 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 questionnaire should contain. The group should include staff who are involved in agricultural planning, in collection of statistics or as a data user within the agricultural sector, so that they 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 large. A basic group of three to five 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.

8.22 For assistance on the subjects to be included, reference can be made to the international recommendations contained in the FAO document "Programme for the World Census of Agriculture 2000", which has attempted to identify the basic information needs of the agricultural sector for the decade 1996-2005.

8.23 Reference should be made to the last agricultural census taken in the country, if available. Starting, with the questionnaire used in the previous census, each of the items included therein could be carefully examined, the content of the questionnaire compared with international recommendations, and each of the questions examined, studying the difficulties encountered and the use made of the information collected.

8.24 As the economic planning in a country becomes more refined and as agriculture changes, the information needs change and items which were not included in the census taken earlier may now be important. For example, the application of fertilizers and the use of improved varieties of seeds were practices which were perhaps not very widespread previously, but which are now important. The reverse may also occur, that is to say that subjects considered useful in the previous census are no longer of any value. The questionnaire must meet the needs of current data users and consider future expectations.

Use of questionnaires developed in other countries

8.25 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 innovations are applicable to the country.

Tabulation plan

8.26 The validity of various questions in the questionnaire can be evaluated by conducting a pseudo-tabulation. Through such tabulation it is possible to determine whether all information targeted from the census can be obtained. It is therefore very important to design the tabulation plan at the same time as the questionnaire. Each question appearing in the questionnaire could then be studied to determine whether it could supply the data needed in the tabulation plan. 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.

Processing the questionnaire

8.27 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 assure that the presentation is simple. 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.

8.28 An identification code should uniquely define each questionnaire and should always be numerical (not alphabetical). It 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. 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 have to have its own code to permit sorting and linking of data. In case of sample enumeration, identification should provide sufficient information for assignment of expansion factors (strata, primary sampling units, area segments, etc.). The identification code should also allow distinction between administrative (or other) areas for which tabulation is required.

Indicate area under different tenure forms:

TENURE FORM	AREA IN Ha
1. Land owned	
2. Land rented from others	
3. Land rented to others	
TOTAL LAND OPERATED (1 + 2 - 3)	

Frame 8.1 Example of numerical value question

8.29 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 Frame 8.1): the answer is specified as a numerical value; e.g. total area of holding, number of persons, age of holder, number of cows, etc.

Indicate legal status of the holder
(check one box only):

- 1 Civil person
2 Corporation
3 Cooperative
4 Other

- (ii) Multiple-choice questions (see Frame 8.2): all possible answers are predetermined (such as yes/no) and the enumerator simply checks, circles or copies only one of them.

Frame 8.2 Example of multiple choice question

- (iii) Multiple-answer questions (see Frame 8.3): same as above except that enumerator checks as many codes as apply. For example source of supply of machinery - owned, provided by landlord, provided by government, etc.

Indicate type of aquaculture installation used for fisheries

(check one or more boxes):

- 1 Pond
2 Rice field
3 Other(specify):.....

- (iv) Introductory questions (see Frame 8.4): usually at the beginning of a section asking if any information in this section is available, or if not to skip to next section. Example: "Any livestock?".

Frame 8.3 Example of multiple answer question

- (v) Open- (or semi-open) ended questions: Response is descriptive either because the possible answers are too many to be precoded or unknown. Examples are found in the crop section of almost all questionnaires. Open question is when no crop is preprinted but enumerator is expected to enter it. Semi-open question refers to "Other, specify" part of the questionnaire (see Frame 8.3) which creates a similar situation.

Any livestock kept on this holding?

- 1 YES - complete this section
2 NO - go to next section

Frame 8.4 Example of introductory question

8.30 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.

8.31 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,

at data entry stage, introductory questions allow skipping to the next section with one keystroke.

8.32 Type (iii) multiple-answer questions, although easily processed, create some confusion for the tabulation plan and record design. It is better to replace such questions with multiple choice questions (type (ii)), sacrificing part of the information (in the example given above, the question may simply be "main type of aquaculture used for fisheries").

8.33 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. The only other way to use these data are to develop codes for minor items and code the answers before data entry.

8.34 For crops, it is preferable to provide a list of those crops which are of interest as a part of the questionnaire and provide pre-codes for the enumerators' use. 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 of the country are known and can be listed.

8.35 Most of the questions in the agricultural census are such that precoding on the questionnaire is possible and it is strongly recommended in order to simplify post enumeration coding and facilitate processing.

8.36 Fully precoded questionnaires are often used in agricultural censuses. The need for this arises because agricultural census questionnaires contain many zero entries; many holdings have no livestock, machinery or hired workers. Only a few holdings in many countries use fertilizers or pesticides, and they will rarely have more than a few crops. Under the circumstances and in order to save time for data entry and reduce the memory space needed on the computer, a different code is assigned to each possible entry in the questionnaire (usually pre-printed in a corner or in front of the box made available for the data). Depending on data processing methods, great economy is possible by entering into the computer only non-zero entries and their code. With modern equipment and software where data entry uses screens for visualizing parts of the questionnaire and permits skipping large parts of questionnaires with "zero" entries, this approach is gradually being abandoned. For this reason, introductory questions inside the questionnaire, permitting skipping parts of the questionnaire by one key stroke, have become very important.

8.37 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 choosing only one parcel/field/plot as the unit of enumeration. This is justified in countries where most of the parcels have just one field or plot. Further simplification is found in Europe and many countries in the Americas 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, data on population can be collected in the form of aggregates (such as number of males under 15 years of age, etc.; the approach was used in FAO Programmes for 1950, 1960 and 1970). 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.

Testing of census questionnaires

8.38 Although the members of the group who designed the questionnaire may be very competent, it is essential that its functionality be evaluated by means of a series of pre-test surveys and pilot censuses. This issue is dealt with in Chapter 13. 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 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 view of the large number of questionnaires and instruction manuals required, sufficient time must be allowed for printing.

Suggested reading

FAO (1965). Some problems of agricultural census taking with special reference to developing countries (by V.G. Panse).

UN (1982). Survey data processing: A review of issues and procedures. NHSCP technical study.

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CHAPTER 9

TABULATION PLAN

The tabulation plan outlines the presentation of information obtained from the agricultural census for the data users. 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. Usually it is developed before or in parallel with the questionnaire.

The tabulation plan should be based on detailed discussions with data users, and should include all required cross-tabulations. In particular, the tabulation plan should indicate proposed tabulations by administrative sub-divisions, taking into account the need to limit the number of tables when conducting a complete enumeration, and limitations in producing tables for small areas when conducting a sample enumeration.

The content of this chapter is in line with the tabulation plan proposed in the FAO Programme for the World Census of Agriculture 2000, and represents the plan for dissemination of census results (Chapter 18).

Introduction

9.1 The tabulation plan should be developed in three phases; first, one should identify information which has high priority and which should be released as early as possible. These tables may be preliminary results from manual tabulations of control sheets or obtained by using a subset of the census data; either a representative sample, or a geographic subset.

9.2 The basic tables are those which are designed to be most useful to a large spectrum of national data users. To assist in the creation of an appropriate group of these tables, a check-list of commonly used cross-tabulations is shown later in this chapter.

9.3 Finally, an additive subset of tables which incorporate country needs and priorities can 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 data base should be designed and used. Additional tables can then be prepared upon request using this data base.

9.4 The field work and processing and dissemination of census data are the two principal components of the census operation and are interlinked. The amount of field work will determine the amount of processing and dissemination. A balance has to be determined between the resources spent on the two components. It has been the general experience that in a well-formulated agricultural census or survey about two-thirds of the total expenditure goes to planning and conducting the field work while one-third is spent on data processing and data dissemination.

9.5 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 and tabulation, resulting in either a delay in tabulation while searching for additional resources

or in part of the data not being tabulated. It must be realized that data collection through a complicated field inquiry is very expensive and if data remain unutilized because they are not processed for any reason, is a waste of national resources.

Talk to the users

9.6 Data users must be consulted during the preparation of the tabulation plan. Considering that the process of organizing an agricultural census may take many years (3 to 6) from the time of formulating the questionnaires until all census reports have been published, users frequently have requests reflecting new government policies, such as additional data on small farms, women's participation in agriculture, etc. It is highly desirable that, as a matter of principle, the tabulation plan, once approved, not be changed because of such requests as these changes will create organizational complications. In some cases resources may need to be reallocated and, perhaps, are not available without additional inputs to the work plan and budget. Flexibility offered by meeting requests mentioned in the section on cross-tabulations or in the section on computer media products in Chapter 18, should meet most additional requirements.

9.7 With electronic data processing and sophisticated data users, one can expect many requests for cross-tabulations; consequently, it is necessary that measures be taken to safeguard data confidentiality, particularly when detailed data breakdowns are made available by size groups and/or small geographic or administrative areas.

Data processing and evaluation

9.8 Data processing is the responsibility of specialized staff and is covered in Chapter 16. Nevertheless, statisticians responsible for census organization should also be continuously involved in the data processing work.

- (i) They should provide the tabulation plan including all details required such as description of codes, lists of names of administrative units, expansion factors (if sample enumeration), etc.
- (ii) They should assist in testing the computer programs prepared for tabulation by providing a special data set for program validation. Specially completed questionnaires may be constructed to verify all possible cases in as few questionnaires as possible. Manual tabulations should also be prepared to check computer printouts.
- (iii) They should systematically check all the tables for internal and external consistency before they are published. This subject is covered in Chapter 16, Quality Checks and Post-enumeration Surveys.

Amount of tabulation for administrative units and the limitations due to sampling

9.9 With the increased demand for tabulations needed for decentralized planning at the smallest administrative units, users should be aware of the limitations of such statistics specifically when sampling methods are employed.

9.10 **Complete enumeration.** If data are collected by complete enumeration, it is theoretically possible to tabulate data for the smallest geographic areas. In fact, even rare characteristics of holdings could be presented. The only restrictions occur when limiting the number of pages in the census report and when ensuring that the tables do not disclose confidential data of individual holdings. For example, if data are classified by size of holding for each village, tables may reveal data for large holdings in each village where only one or a few large holdings exist. In many countries there is a legal obligation to treat confidentially

data on individual holdings and this commitment must be honoured. In some census laws there is a penalty for disclosing confidential data.

9.11 **Sample enumeration.** In many countries a complete enumeration of holdings may not be feasible because of cost, time, and/or staffing constraints. In sample enumerations the results are subject to sampling error making it impossible to interpret results for data items with only a few observations. 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 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.

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

Preparation of the tabulation plan

9.13 In setting up a tabulation plan for an agricultural census, consideration should be given to the type of information needed by the country as well as by international agencies. Communications between producers and users of statistics should, therefore, be established early in the preparatory stages of the questionnaire. The importance of forming a group of experts drawn from user organizations for formulating the questionnaire has been discussed in detail in Chapters 2 and 8. This group should involve professionals who know the agricultural economic situation and its problems and who have the expertise to identify data needs. This 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 tabulation plan is planned during the same period as the design of the questionnaire to ensure that items of information needed in the tabulation will be collected and recorded on the questionnaire.

9.14 The agricultural census office should observe and take note of the type and frequency of requests received from various agencies and catalogue the demand and identify data which may not be available from other sources.

9.15 Reference is made in Chapter 10, Census Publicity, to the fact that the objectives, scope and coverage of the census should be widely brought to the notice of the public so that they are aware of the utility as well as the limitations of census results. The public in general and agricultural planners in particular should also be informed well in advance of the census whether it is to be a sample enumeration or a complete enumeration census. This may avoid requests for additional information that arise after field work has been completed. For example, if the census has been conducted on a sampling basis it may not be possible or reasonable to tabulate the data, which an agricultural planner may subsequently request for smaller administrative areas.

9.16 There are several reasons why the tabulation plan should be prepared early and not changed subsequently without important motives.

9.17 The tabulation plan is needed 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.

9.18 Data requirements for lower administrative levels will affect decisions taken on the size of the sample in sample enumeration censuses.

9.19 A number of other census activities may benefit from knowing the tabulation plan, such as planning the manual process of preliminary data collected by field supervisors, 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 before submission to the central office and preparing any other tabulations required by local authorities.

9.20 After the items of information 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 and significant and easily used by data users.

9.21 When preparing the tabulation plan for individual countries the following should be kept in mind:

- (i) The number of priority tables should be restricted in order to make them quickly available to permit rapid dissemination. These tables may include all data collected but with limited cross-tabulations or possibly in different volumes so that the more important data are available very early.
- (ii) Further analysis should be facilitated by:
 - providing additional cross-tabulations;
 - making available raw data to users in the form of a data base (still protecting confidentiality);
 - making available facilities for the production of special tables requested by users. (In this respect, it can be said that with new developments in computer technology, it becomes less and less useful to print a large set of tables, and more and more useful to invest in a system capable of producing tables upon request.)

Cross-tabulations

9.22 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 important classification criteria can show the influence of various factors on agricultural production.

9.23 However, it is a common practice to first determine the items or characteristics to be classified and the groupings 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.

9.24 The Programme for the World Census of Agriculture 2000 proposes the following 11 classification criteria:

1. Total area of holding
2. Total area of agricultural land of holding
3. Number of livestock on the holding

4. Purpose of production
5. Number of permanent workers
6. Land tenure
7. Holder's legal status
8. Size of holder's household
9. Holder's age
10. Holder's sex
11. Irrigation

9.25 Table 9.1 provides a check-list of commonly used cross-tabulations, which are indicated with an x. Columns 1-11 give the main classification criteria; the stub contains various characteristics by category. Category 01, providing data needed to classify holdings by administrative units and agro-ecological regions, is not included in the tables, as all basic cross tabulations apply to all administrative units and agro-ecological regions.

9.26 Careful planning at an early stage is needed to determine which data will be shown at which levels of administrative (or other) subdivisions. This plan can be shown as a part of the table of basic cross-tabulations. In fact, the symbol "x" can be replaced by other symbols indicating administrative level or agro-ecological regions for which the specific cross-classification is planned. For example, the following symbols can be used:

- T - country totals only
- P - tables envisaged at country and provincial level
- D - tables envisaged at country, provincial and district level
- A - tables envisaged for agro-ecological regions.

9.27 Furthermore, classification of data by administrative areas should be considered as one of the most important criteria for classification. In a number of national census reports, cross-classifications are limited to showing all data classified by (i) administrative subdivisions and (ii) total area of holding.

9.28 One basic classification 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. Since size classification has been used in reporting past censuses this classification should be retained for continuity and comparability. 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.

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

9.30 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.

9.31 Classification by purpose of production is intended to show data separately for holdings which do/do not utilize the marketing structure. 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 household farming and cooperatives, state farms, corporations, etc.

Table 9.1 - Cross-tabulations check-list

Characteristic headings	Holdings and characteristics of holdings to be classified by										
	Total area of holding	Total area of agricultural land	Number of livestock	Purpose of production	Number of permanent workers	Land tenure	Holder's legal status	Size of household	Holder's age	Holder's sex	Irrigation
	1	2	3	4	5	6	7	8	9	10	11
Category 02 - General characteristics											
Holder's legal status	X	-	-	X	X	X	-	-	-	-	X
Use of hired manager	X	-	-	X	-	-	-	-	-	-	-
Other economic activities	X	-	-	X	-	-	-	-	-	-	-
Purpose of production	X	X	-	-	X	X	X	X	X	X	X
Category 03 - Demographic characteristics											
Holdings by size of holder's household	X	X	-	-	-	X	-	-	X	X	-
Holder's and members of their households by sex and age	X	-	-	-	-	X	-	-	-	X	-
Holder's and members of their households by education	X	-	-	-	-	X	-	-	-	X	-
Holder's and members of their households by marital status	X	-	-	-	-	X	-	-	-	X	-
Category 04 - Employment											
Holder's and members of their households 'economically active by age and sex	X	-	-	X	-	X	-	-	-	X	-
Holder's and members of their households by main occupation	X	-	-	X	-	X	-	-	-	X	-
Holder's and members of their households by type of work (permanent, occasional)	X	-	-	X	-	X	X	-	-	X	-
Holdings by number of permanent workers (members of holder's household and hired)	X	-	-	X	-	X	X	-	-	X	-
Holdings hiring permanent and occasional workers	X	-	-	-	-	-	X	-	-	-	-
Hired permanent workers by sex and skilled or unskilled	X	-	-	-	-	-	X	-	-	-	-
Category 05 - Land and water											
Number and area of holdings	X	X	X	X	X	X	X	X	X	X	X
Number of parcels by size of parcels	X	-	-	-	-	-	-	-	-	-	X
Tenure of land	X	-	-	-	X	-	-	X	X	X	X
Land use	X	X	-	-	-	-	-	X	X	X	X
Land by irrigation	X	X	-	-	-	X	-	-	-	-	-
Land under shifting cultivation by year cleared	X	-	-	-	-	-	-	-	X	X	-

Characteristic headings	Holdings and characteristics of holdings to be classified by										
	Total area of holding	Total area of agricultural land	Number of livestock	Purpose of production	Number of permanent workers	Land tenure	Holder's legal status	Size of household	Holder's age	Holder's sex	Irrigation
	1	2	3	4	5	6	7	8	9	10	11
Category 06 - Crops											
Major temporary crops	X	X	-	X	X	X	X	-	X	X	X
Other temporary crops	X	X	-	X	-	X	X	-	X	X	-
Major permanent crops	X	X	-	X	X	X	X	-	X	X	X
Other permanent crops	X	X	-	X	-	X	X	-	X	X	-
Use of fertilizers	X	-	-	X	-	-	-	-	-	X	X
Use of pesticides	X	-	-	X	-	-	-	-	-	X	X
Use of high yielding crop varieties	X	-	-	X	-	-	-	-	-	X	X
Category 07 - Livestock											
Holdings by livestock production system	X	X	X	X	X	-	X	X	-	-	-
Holdings by number of livestock (for each relevant kind of livestock)	X	X	X	-	X	X	X	-	X	X	-
Livestock by sex, age and purpose (for each relevant kind of livestock)	X	X	-	X	X	X	X	-	X	X	-
Poultry (for each species)	X	X	-	X	X	X	X	-	X	X	-
Category 08 - Machinery and equipment											
Number of stationary power-producing machinery by source of supply	X	X	-	X	-	X	-	-	X	X	-
Use of other agricultural machinery by source of supply	X	X	-	X	-	X	-	-	X	X	X
Category 09 - Buildings and other structures											
Use of non-residential buildings by tenure	X	-	X	X	-	-	-	-	-	X	X
Area and volume of non-residential buildings by purpose	X	-	X	X	-	-	-	-	-	X	-
Category 10 - Other activities											
Number and area of forest trees	X	-	-	X	-	-	X	-	X	X	-
Fishery activities and kind of aquaculture installations	X	-	-	X	-	-	X	-	X	X	X

9.32 Different measures of size of agricultural operations are often classified by number of permanent workers (a measure of labour inputs) and by size of the household (a measure of food requirements in subsistence agriculture).

9.33 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.

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

Presentation of the tabulation plan

9.35 In order to be useful the tabulation plan should be clear and comprehensive. The classical presentation is to prepare "dummy tables" in a condensed form for all data to be tabulated. A dummy table is prepared in the size and form of the table planned for publishing, except that it contains empty cells. An example is shown in Table 9.2.

**Table 9.2 - Example of a dummy table
"Number of holdings by total area of holding and by purpose of production"**

Purpose of production	Number of holdings producing mainly for home consumption	Number of holdings producing mainly for sale	TOTAL
Total area of holding			
All holdings with and without land			
Holdings without land			
Holdings under 0.5 hectare			
0.5 hectare and under 1			
1 hectare and under 2			
2 hectares and under 5			
5 hectares and under 10			
10 hectares and under 20			
20 hectares and under 50			
50 hectares and under 100			
100 hectares and over			

9.36 In this dummy table, basic data referring to "holdings by purpose of production" are distributed by an example of classification of total area of holdings. A complete set of such dummy tables required to describe the tabulation plan would engage the same space as the final report. Some economy of space can be made considering that presentation of basic data and classes used for cross-classification (size classes in the dummy table given as an example) need not be repeated in each dummy table.

9.37 A way of condensing the presentation of the tabulation plan is to show separately:

- (i) All basic data (e.g., number of holdings by purpose of production).
- (ii) Classes for each of the planned classification criteria (e.g., size classes used in Table 9.2).
- (iii) Table of basic cross-tabulations (see Table 9.1).

9.38 It is irrelevant whether basic data are shown in the heading and classes relating to classification criteria in the stub of the table, as shown in the dummy table above, or vice versa, although there may be some advantage in space economy and computer

programming, to show basic data in the stub and classes for classification criteria in the heading. Similarly, all data classified by use of one specific cross-classification criterion can be shown in one long table, as is done by some countries. Some guidelines for presentation of tables can be found in Frame 9.1.

9.39 In summary, it should be stressed that the tabulation plan is one of the most important documents in the census preparation and organization process. A major effort is required to prepare it. Once it is prepared it should seldom be changed unless mistakes are found and even then, it is necessary to verify that adequate resources are available to undertake the new activities. If the tabulation plan is changed for some reason, all users mentioned above, internal and external, should be informed.

Suggested reading

FAO (1987). Microcomputer-based data processing: 1990 World Census of Agriculture.

FAO (1995). Programme for the World Census of Agriculture 2000.

UN (1980). Principles and recommendations for population and housing censuses. Statistical papers, Series M, No. 67.

UN (1982). Survey data processing: A review of issues and procedures. 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, Series F, No. 54.

A table is always a collection of figures inserted in cells. Care should be taken to produce legible tables (not too many cells on many pages, for example) and to document them as follows:

TITLE:

UNITS: xxx

A \ B				Total
Total				

Source:

Footnote:

TITLE: (required) the title must at least identify what is reported and according to which criteria. Example (note: row characteristic appears first):

Number of units reported by size of A and by type of B.

UNIT: (optional) identifies the unit of measurement for the numbers in the table; examples are US\$, hectares, kilograms, (kg.), etc.

A,B: classification variables or codes (which may be sub-classified).

SOURCE: (required) indicates the source/agency which provided the data. Example: Census of Agriculture of Swaziland (1988).

FOOTNOTE: contains special information about the data in the table; for example, sample survey.

TOTAL: aggregate values for columns and rows (may appear before or after individual column or row data).

Frame 9.1 Table presentation

CHAPTER 10

CENSUS PUBLICITY

The main purpose of census publicity is to ensure the cooperation of holders to provide the requested data. This is an essential part of the census preparations which has to be planned, taking into account, local conditions.

This chapter provides some suggestions and examples on possible media publicity and on the timing of the publicity campaign. Related chapters are Chapter 1 where census legislation guarantees confidentiality of data by the government and publicity of such is an important aspect of ensuring holders' cooperation, and Chapter 18, where the census dissemination programme can be used as a promotional campaign on the use of census data.

Organization of publicity campaign

10.1 Conducting an agricultural census is a complex operation in which all governmental agencies dealing with the rural sectors of the economy are involved. Items of information collected in the census deal directly with the agricultural economy. There are some items, such as the extent of cultivation, land tenure, etc., which may be of a very sensitive nature and the holders will generally be reluctant to answer such questions and supply correct information unless they are fully convinced that the information supplied by them will not be used for tax purposes or used against them in any way. Such reluctance on the part of the holders is likely to be stronger in countries where an agricultural census is being conducted for the first time.

10.2 The success of the census and the quality of the information will largely depend on the cooperation of the holders and their willingness to provide the requested information. Every effort has to be made, particularly in countries where agricultural census taking is not a regular event, to seek the cooperation of the holders and their organizations and governmental agencies dealing with rural development programmes. The census publicity campaign should be designed to sensitize the public 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 Chapter 18 on this topic).

10.3 A primary function of the Agricultural Census Steering Committee, as already mentioned in Chapter 2, should be to undertake the responsibility of preparing a coordinated work plan and time-table for census publicity in connection with the agricultural census in all aspects and at all levels, with the aid of publicity experts. In many cases a special sub-committee will 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 should make use of all publicity media in their individual provinces.

10.4 These committees can help in planning an effective publicity campaign for the census taking into account the prevailing social and economic background, the means of communication available, etc. Publicity has to be directed at educating the holders, who are to supply the information to be collected through the census. They are frequently illiterate, 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 primarily for their own benefit is the purpose of the census publicity programme. It should be explained, through an appropriate communication medium that can easily be understood by respondents, 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, modern agricultural implements, marketing and storage facilities, etc. 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.

10.5 It is important also to convince the holders of the confidential treatment of the data they supply and assure them that this information is for statistical purposes only and will not be used against them by any organization or law for any purposes such as levying taxes, procurement of produce, etc. They should also be told that individual information will not be made available to anyone outside the census organization, which will release the census information only in an aggregate form or in such a way that individual data cannot be identified.

10.6 If the agricultural census is taken on a sampling basis, only a small proportion of holders will be interviewed. This fact is likely to cause suspicion in the minds of both groups of holders, those interviewed and those not interviewed. It is essential that this suspicion be removed. The holders must understand through simple language why a particular holder was selected for interview and not the neighbour and why only a sample of holders was being interviewed.

10.7 The agricultural census cannot succeed in collecting the facts about a country's agriculture unless the respondents view it in a favourable light and are prepared to cooperate wholeheartedly by providing correct information. A well-planned publicity campaign is therefore essential to create a favourable environment for the census.

Types of media

10.8 The types of publicity media used will largely depend on availability and on a country's socio-economic structure. In most countries wide use is made of local and national newspapers, radio and television. If there is a well organized agricultural extension agency concerned with agricultural operations and in close contact with the farming community, it can be a very good publicity medium for sensitizing holders about the agricultural census. Educated holders can be supplied with a pamphlet indicating the purpose of the census. To reach illiterate and remote populations, radio and television talks and messages broadcast by important personalities (President, Minister of Agriculture, etc.) well known to the holders can be extremely valuable. Lectures and lessons in rural schools on census topics are also helpful. Well designed and colourful posters of various sizes suitable for being exhibited inside and outside buildings are effective in attracting the rural people. Cinema films, videos and slides exhibited in mobile vans in rural areas are also a very useful, although somewhat costly, means of familiarizing holders with the aims and purposes of the agricultural census. Holders can also be informed through village meetings, conferences of grower or producer associations, etc. Educating and informing local leaders,

village headmen, and elders and other persons of influence is also an important first stage in reaching the holders and securing their cooperation.

10.9 The use of a census 'theme' and 'slogan' has proved very effective in many publicity campaigns and it is important to identify these at an early stage in the campaign.

Timing, duration and frequency of campaign

10.10 The publicity for the agricultural census should start slowly and reach a climax at the time of the census enumeration. 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.

10.11 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. This should be done through the radio, television and newspaper media when the final results of the census are released for general use (see Chapter 18).

Other possible action to obtain support and cooperation of holders

10.12 In addition to the holders, the aim of the census publicity should be to create a general awareness among the population at large. Cooperation of local government officials, i.e., agricultural extension agents, land record officials, school teachers, etc., can be enlisted for this purpose. Cooperation of an educated public can be obtained through the media of newspapers, magazines, clubs and periodicals on a variety of topics connected with an agricultural census. Distribution of pamphlets and leaflets about the census and printing new series of picture postcards and postage stamps prominently mentioning the census date are also useful. Preparation of a small pocket census manual and distribution of copies to all government officials concerned with rural development activities will also be useful. Dropping leaflets and candies with suitable messages from an airplane has also been tried in some countries. A well-publicized census will make its implementation much smoother and more successful.

Examples of media

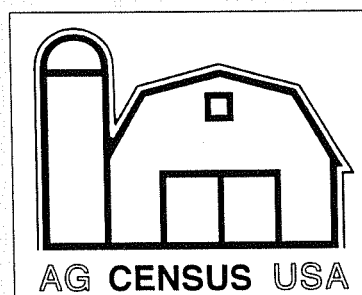
10.13 Different countries adopt different media for publicity depending on what is available, effective and cost efficient. In some countries of Latin America, the publicity for the agricultural census was given through free distributions of comic literature among the schoolchildren. The theme of the comic was a conversation between the schoolboy and his father explaining what the agricultural census was about and how it could benefit them.

10.14 In the 1987 agricultural census in the United States of America, which was conducted basically as a mail-out/mail-back survey, the pre-enumeration awareness programme had three major goals:

- (i) Make the agricultural community (holders, ranchers and agri-business data users) aware of the census.

- (ii) Encourage everyone to respond (to increase overall response rate).
- (iii) Increase the response during the early days of the census.

10.15 The Bureau of the Census selected the slogan "America counts on Agriculture" which was reproduced on posters, press releases and other publicity materials. The Bureau also developed a census logo depicting a barn and a silo with the words "AG CENSUS USA" below it (see Frame 10.1). This logo was reproduced on posters, T-shirts, baseball hats, etc., as well as on all census instruments, questionnaires, manuals, and publications.



Frame 10.1 Logo (example)

10.16 The main publicity campaign relied mostly on traditional media: radio, television, newspapers and magazines as well as on the distribution of printed material. Special presentations were made at grower and producer organizations' meetings at both national and local levels.

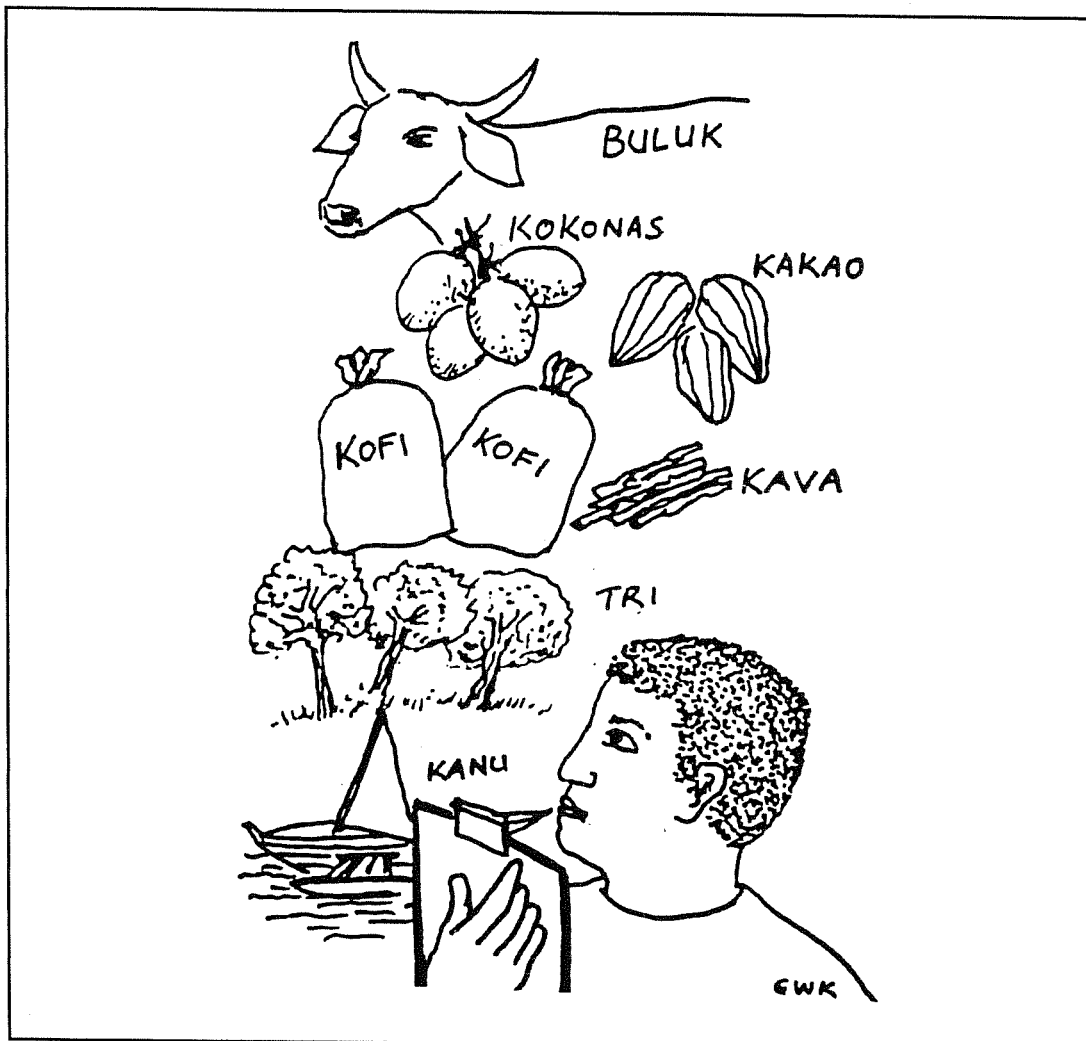
10.17 After the census, there was a publicity campaign to inform potential data users of the kinds of data being published and their availability. Part of this publicity was a 38-page publication *Guide to the 1987 Agricultural Census and related statistics*, providing details of the publication plan of the census data and a description of other related information available.

10.18 In Vanuatu (1993) the publicity campaign was mainly conducted with radio talk shows, a census song and distribution of posters (see example in Frame 10.2), tee-shirts and brochures.

Suggested reading

UN (1992). Handbook of population and housing censuses: Part I, Planning, organization and administration of population and housing censuses. Studies in methods, Series F, No. 54.

Hamas ?



*Man Blong Senses I Kam Blong
Kaontem Evri Samting We Yu Gat
Senses '93 Planem Fuija Blong Yumi*

Frame 10.2 POSTER EXAMPLE

CHAPTER 11

INSTRUCTION MANUALS

This chapter explains the need for instruction manuals and describes their content. It should be kept in mind that enumerators will have only limited training and work very independently, often in remote areas, generally without the possibility of consulting their supervisors. The primary purpose of the instruction manuals is as a reference for answering questions which may arise during the interviews.

There is usually a separate manual for enumerators and supervisors. The manual for supervisors includes enumerator instructions plus additional information for supervisors. The content of the manuals refers to all the questions on the questionnaire and includes concepts and definitions, techniques of interviewing and also duties and obligations of enumerators and supervisors. The manuals, like the questionnaires, have to be prepared very early so that, after testing them in the field on the pre-test or pilot census, enough time is available for their review and updating and for the printing of a sufficient number of copies.

The manuals are the primary documents used for training enumerators (see Chapter 12). Those preparing the manuals are advised to find samples of manuals prepared under similar conditions from previous censuses, or from neighbouring countries, because space limitation does not permit inclusion of examples in this publication.

Purpose of the instruction manuals

11.1 The quality of data collected during a census depends on the quality of field work performed by the enumerators and the supervisors. A description of the method of their recruitment and training is given in Chapters 4 and 12. 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 the short training period and they therefore need printed 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 fulfil 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.

11.2 The manuals clearly establish the criteria and procedures to be followed and the work expected to be achieved during the census. The majority of the staff could carry out the census work and resolve their own problems, 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.

Timely preparation of manuals

11.3 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 delay the preparation of the manuals until a training course for census executives is conducted with the intention of including all suggestions that might emerge during this course. It is highly preferable to have draft manuals at this stage, since the time available before subsequent courses may be insufficient to prepare enumerator and supervisor manuals and their training courses should not be held without manuals. 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, and it is therefore essential that they are able to rely on a printed 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 finalised only after the census questionnaires and various administrative procedures are finalised, which is another reason why early census preparations are essential.

Authors of the instruction manuals

11.4 The instruction manuals should be prepared by people who are conversant with conducting an agricultural census, 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.

11.5 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 who have participated in previous censuses 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 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 can 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 to the staff having the lowest level of education but meeting recruitment requirements for the job. The inclusion of explanations in the manuals which may appear very elementary is justified. It is usually a very good idea to take into consideration manuals from neighbouring countries with similar cultural backgrounds, particularly if the census is being organized for the first time.

Presentation of the instruction manuals

11.6 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. 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 avoided, or the desired meaning should be emphasized.

Format of the instruction manuals

11.7 The instruction manuals should not be large, preferably in the range of 45 to 60 pages and small enough to fit conveniently into a pocket, and thus always be with the census personnel (21 × 15 cm (A5 format) may be a good choice). Care, however, must be taken to ensure the manuals address all points of the work.

11.8 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.

11.9 It 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.

11.10 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 Objectives of the census; etc.

11.11 It is essential that the paper used for manuals be of good quality, so as to withstand frequent handling without becoming torn or damaged, and the print should be clear. As the staff will be working in the field most of the time, exposed to all weather conditions, the cover page should be weather resistant and of a colour which attracts attention so it can be located easily among census papers.

Contents of the instruction manuals

11.12 Basically three types of field staff exist, namely the enumerator, the supervisor, and higher level or headquarters staff, and the use of the manual content is different for each of them. However, there are a series of items which are common to all census officers, such as the purposes of the census, basic definitions, explanations of the legal basis, 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 three separate manuals are printed, but this system has several potential problems. Sometimes three separate manuals are prepared but printed together forming a single volume. Both systems have advantages and perhaps the only objection to a single volume is its size.

11.13 Whichever form is chosen to present the instruction manuals, the order of the items must be logical. 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 class of person (or authorities) whose collaboration they might need.

11.14 The manuals should deal with the following issues:

- 11.14.1 **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 is discussed below.
- 11.14.2 **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 enumerator that an agricultural census is an inquiry on the structure of the agriculture sector of a country. Information on the primary producing unit, the agricultural holding, is collected. The objective is to include all holdings producing crops, livestock and livestock products, regardless of size and location. However, economic and practical considerations may limit the coverage to holdings meeting certain specifications. It should be clearly stated whether the specifications limiting coverage are based on area, on a certain number of livestock, on a minimum quantity or minimum value of agricultural output or agricultural production intended for sale and/or for consumption, or on a combination of these.
- 11.14.3 **Organization responsible for the census.** In a census operation, many problems may arise if the guidelines are not well defined and if there is no organization. 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 2). 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. The enumerator's report on the questionnaires completed and the material they will receive should be included so that when they deliver the material to the supervisors they can check that it is complete, or if not, take the necessary measures to assure its completeness.
- 11.14.4 **Legal aspects.** 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 and only in extreme non-response cases use the argument of these sanctions.

11.14.5 **Confidentiality of census data.** Emphasis should be on the obligation undertaken by census officers to maintain the confidentiality of data obtained, plus some additional precautions, such as keeping completed papers 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. A statement should be prepared on the obligations census officers have 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.

11.14.6 **Definitions and concepts.** A chapter should be devoted to the definitions and concepts which are utilized in the census, which must be thoroughly understood and memorized by the field staff. Among them are the census unit (often the agricultural holding), geographic coverage, time reference of data to be collected, crop year, and a short explanation of sampling methodology, if applicable.

11.14.7 **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, 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.

11.15 There are some accepted, general indicators which may help beginners 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

11.16 The basic contents of the enumerator's manual may be as follows:

- (i) Why the census is being taken and its importance
 1. Objectives of the census
 2. Uses of census information
- (ii) General information about the census
 1. Nature and scope
 2. Definitions and procedures
 3. Method of collection
 4. Time reference
 5. The census field organization
- (iii) The interviewer and interviewing
 1. Desirable attributes of the interviewer
 2. Preparation for the interview
 3. Tips on interviewing
 4. Resolving common problems in interviewing
- (iv) The questionnaire
 1. Basic concepts and definitions
 2. Item by item explanations of exactly what kinds of data are expected for each question and how to make the proper entries

- (v) Other census forms
 1. Mapping and listing forms
 2. Conversion tables and related tables.
- (vi) Objective measurements (when envisaged)
 1. Measurement of areas
 2. Measurement of yield (crop-cutting)
 3. Use of pocket calculator for area measurement

Annex 1 Administrative instructions

Annex 2 Examples of completed questionnaires

11.17 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 them.

11.18 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 14). 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

11.19 The supervisor's manual may include the following sections, in addition to what is suggested for the enumerator's manual:

- (i) General responsibilities of the supervisor.
- (ii) Selection, recruitment and training of enumerators.
- (iii) Preparation of mapping, listing and other census field materials.
- (iv) Field supervision, checking, editing and progress report.
- (v) Preparation of summary of most important data (when envisaged).

11.20 In order to discharge the duties of supervisor it is necessary that guidelines as recommended be prepared so that all procedures will be uniform.

11.21 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 who are in direct contact with the enumerators are in the best position to assist and encourage them to work efficiently and correctly.

11.22 The general description of the supervisors' work is extensive since their functions vary. They include work prior to the census such as checking maps and lists of important holdings which must be surveyed in the area allotted to them, and in some cases help in the preparation of such lists; they also hire and train enumerators in their jurisdiction. During the census they will observe the interviews carried out by enumerators, check at least some

of the data obtained, so as to be sure that the interviews have actually been carried out and the data not invented by the enumerator, and in some cases (e.g., if the enumerator is sick) the supervisor will also have to interview the holders and complete questionnaires. They will edit the completed questionnaires, if required summarize some of the most important data which will serve to provide the immediate results of the census, and send the questionnaires and list of holdings to the provincial office. In countries where the field area is measured by compass-bearing method, supervisors may be equipped with programmable pocket calculators to calculate the field area and closure error when they are in the enumeration area so that measurements can be repeated if necessary. 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.

11.23 They may also be assigned further duties: the 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. Generally, the distribution of staff and workload is carried out in the central office by dividing the country into census sectors, such as areas which are assigned to each enumerator, but in other cases, due to the lack of updated or less reliable maps, the supervisors are assigned administrative units which, in principle, are easily identifiable in the field and are given the responsibility of pre-listing holdings and distributing work to enumerators who will be under their jurisdiction. They must be given precise rules to facilitate their work, so as to avoid duplication or omission of areas of their work. It is essential that a sketch be prepared on which the area assigned to each enumerator is shown and these sketches later sent to the central office where they will be used for various other purposes. It must be specified whether the preparation of the sketches is the task of the supervisor or of the enumerator. Generally it is done by the enumerator.

11.24 Having sketches of the areas assigned makes it possible to evaluate the census and makes supervision easier. 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. The supervisor can then control the progress of the work very carefully by making necessary adjustments.

11.25 A preliminary list of holdings is not always made, but nearly always there is a list of the most important census units, which in the majority of cases is based on the results of previous censuses and is sometimes updated by information supplied by grower or producer associations or other bodies connected with the agricultural sector of the country. The supervisor must be given instructions to check and update the list and use it in checking the work of the enumerator. Sometimes, the supervisors will have to prepare the list of the most important holdings in their area, in which case they must be told the criteria to follow in order to judge whether a holding is important and which agencies and persons might be approached to obtain the information needed for the preparation of such lists.

11.26 If the census is based on a sample, the supervisor may be responsible for the selection of the sample, and it is essential that the instructions in the manual be very clear and precise. It should be 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 sample enumeration.

Training of enumerators

11.27 The supervisor will often be responsible for training enumerators. 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 effect, a course agenda must be in the manual. This will assure that all subjects are covered, each given its due importance.

11.28 Supervisors should be told 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. Supervisors should be informed that such activities will be the same as those carried out during their training. The practical field work should be carried out in an area near the training site and cover all stages of the census organization, from the identification of the boundaries of the enumeration area to the editing of completed questionnaires.

11.29 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 12.

Intensity of supervision

11.30 The supervisors will have to review the work of enumerators; consequently, it is necessary that they establish a timetable for this activity. Supervision should be more intense during the first week of the census so that enumerators' mistakes can be immediately corrected. At the beginning of the review of the enumerators' work, the supervisor should already know the quality of field work being done by their enumerators. They may plan future inspections in such a way that they are more frequently available to guide those enumerators who are not performing adequately and not following the procedures for census taking. The supervisors should accompany each enumerator assigned to them during the first one or two interviews, before allowing them to work on their own, and then visit on a regular scheduled basis during the enumeration period (it may be necessary to make unscheduled visits if work performance is inadequate).

11.31 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.

11.32 One of the functions of the supervisors is to ensure that the census is finished on schedule. For this to happen they must control 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. They will generally have printed forms on which to make the needed 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 14).

Authority of the supervisors

11.33 The supervisors must have the authority to deal properly and summarily with enumerators who are not performing satisfactory work. As a last resort they will have to dismiss non-performing enumerators. The replacement of enumerators is a problem which

supervisors will face, not only for non-performance but for other reasons also, such as illness, family problems, accidents, or quitting. They should receive guidance in the manual on how to resolve such problems, 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 early and who can be transferred to the areas needed once they have finished the work originally assigned to them.

How to solve the difficulties of the enumerators

11.34 The enumerators will receive instructions during training on solving problems which are expected to occur most frequently. They should report to their supervisors other problems which arise that they cannot solve. 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 take initiative to solve such problems and only in extreme cases will they refer such problems to the area coordinators for instructions on how to proceed.

11.35 The enumerators will 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 province. In spite of these endeavours, it will not always be possible to obtain the desired information. Instructions should be given to the supervisor on how and when to apply sanctions which have been established by the legislation.

11.36 The editing of the completed questionnaires is a major task which the supervisors must perform. It is very laborious work and they should be given practical rules to be able to do it efficiently. These rules may consist of editing only some sections of the questionnaire which are fundamental, or some questions which are known to be difficult to answer and the reply may contain serious errors, or the question may not have been answered at all. Initially they will edit all questionnaires for enumerators under their jurisdiction. This procedure 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. 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.

11.37 In some countries the supervisors are asked to sign all questionnaires they have reviewed; this practice is not necessarily useful. In addition to affording an opportunity for correcting the work of the enumerators and improving the quality of the information obtained, 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 they should all use a specific coloured pencil. 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.

11.38 The supervisors are often asked to make summaries of the main census results being obtained. 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.

Manual for the provincial coordinators

11.39 The provincial coordinators' manual may include the following sections in addition to that included in the supervisors' manual:

- (i) Selection of applicants for the supervisor posts
- (ii) Training of supervisors.
- (iii) Receipt and editing of questionnaires and other forms completed in the field.
- (iv) Dispatch of progress reports on the census.
- (v) Summary report on preliminary data.
- (vi) Instructions on administrative aspects in relation to the checking of expenses, payment of wages, rejection of faulty work, application of sanctions to officers, etc..
- (vii) Dispatch to the central office of all the documentation dealt with.
- (viii) Final Report. Format the same as that for the supervisor but containing more subjects.

11.40 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.

11.41 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 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.

11.42 Although the publicity campaign for the census will have been planned in the central office, the provincial coordinators should be sent publicity materials prepared for them to distribute. They will need to promote some publicity activities through local media such as broadcasting stations, television, cinemas, posters, etc., for which they will be given instructions and advised of funds available for this purpose.

11.43 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.

11.44 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.

Suggested reading

INSEE (1962). Manuel d'enquêteur agricole (Service de cooperation).

CHAPTER 12

TRAINING PROGRAMME

The census training programme covers various categories of staff involved in census activities. Some of their training can be covered by educational facilities available in the country, universities or similar facilities (data processing, sampling, etc.). Training of census organizers concerns only a few technicians in a country and, if possible, should be covered by international training centres. The most important training is that of the field staff, enumerators and supervisors. In larger countries, this training may have to be organized at different levels, starting with the training of trainers, and be organized very early so these staff are trained in time to become available to work on census preparations.

This chapter describes training activities that may be organized at the international or national level, and provides a detailed programme for the training of enumerators and supervisors. The related topics are the Instruction Manuals (Chapter 11), Census Enumeration (Chapter 14) and the Organization of Field Work (Chapter 15), which represent the main activities of the field staff.

Introduction

12.1 An agricultural census collects data on a number of agricultural operations and the methodology for obtaining such data may be different for individual items. The reference date is not the same for all items. The respondent often needs assistance in providing the required information, particularly in developing countries. Reporting is often complicated for respondents who do not know international units of measure. In large countries taking an agricultural census is very complex because of variability in the socio-economic structure between provinces. For this reason, the training of census staff, from top officials to census enumerators, should be organized in a planned and coordinated effort before each census.

12.2 The census organization would normally consist of various levels of employees. 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. The following categories of employees are normally involved in census programmes:

- (i) High-level census organizers responsible for census organization and administration.
- (ii) High-level specialized technical staff responsible for methodology of agricultural censuses: design of census questionnaires, organization of data processing, sampling design, etc.
- (iii) Technical staff responsible for data entry, manual editing, filing of questionnaires, etc.
- (iv) Trainers of trainers.
- (v) Trainers of enumerators and supervisors.
- (vi) Supervisors
- (vii) Enumerators.

12.3 Training needs for the above categories 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). 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 receive on-the-job training. For countries with little or no tradition in census taking, international training should be organized.

12.4 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.

12.5 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 updated by using the experiences of the previous census. Accommodation for training classes for trainees, and the supply of blackboards, projectors and other requisites for holding a class, have to be provided if the training programme is to become a success.

12.6 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.

Training at international centres

12.7 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. Developing countries should identify qualified persons for this training who will be placed 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.

12.8 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:

- (i) Census plan design and preparation
- (ii) Sampling techniques.
- (iii) Design of questionnaire and its field testing.
- (iv) Pilot census.
- (v) Data processing.
- (vi) Drafting census reports.

12.9 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 developing 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 is highly recommended.

12.10 A series of international courses is available on related subjects. FAO organizes a number of National Demonstration Centres (NDCs) for groups of neighbouring countries. NDCs are normally organized by a country preparing an agricultural census and, as part of requested preparation assistance, FAO can provide training for a period of three to four weeks to neighbouring countries using FAO technology and methodology.

Training at national centres

12.11 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. 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.

12.12 Actual contents of the training package for census staff will vary from country to country, depending on the status and development of agriculture. The broad areas on which emphasis in training should be made are as follows:

- (i) 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.
- (ii) 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 local supervisors and enumerators are trained at the provincial level.
- (iii) 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.
- (iv) 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.
- (v) Training should instill the serious nature of the work and ensure positive participation during the training course.
- (vi) Training should be carefully organized and outlined with an appropriate agenda and time schedule.
- (vii) 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.

Duration and content of enumerator training courses

12.13 The number of enumerators in the agricultural census may be quite large, particularly in a large country organizing a complete enumeration census. In China, more than four million enumerators are considered necessary. 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.

12.14 Instructions for and training of enumerators are most important because the quality of the census results depends almost wholly on enumerators. The instructions for enumerators, should be contained in well-prepared manuals written in simple local languages (see Chapter 11 Instruction Manuals). These manuals serve both as an instructional text and as a reference guide during enumeration. 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 landholders. In the case of multi-language countries such manuals should be prepared in each of the local languages.

12.15 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 knowledge of agriculture. The training should be oriented to prepare the enumerators to:

- (i) Be conversant with the legal provisions of the census and know their own rights and responsibilities.
- (ii) 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 questionnaires containing typical errors and problems could be prepared for them to edit and review in class.
- (iii) Read maps, prepare usable sketches, and identify individual parcels and determine their areas.
- (iv) Be able to estimate, if necessary, the number of scattered trees, distinguish between trees of bearing and non-bearing ages, and identify important crops.

- (v) Be able to measure the areas of parcels and crop yields using instruments if objective measurements are adopted as a method of data collection.

12.16 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.

12.17 The following subjects may be included in the training programme:

- (i) **Background information**
 - (a) Information regarding agricultural conditions prevailing in the country
 - (b) What an agricultural census is; why it is taken; its importance and use.
- (ii) **General information for the enumerators**
 - (a) The job
 - (b) Their responsibility
 - (c) Their place in the census organization
 - (d) Their relations with the respondents
 - (e) The Census Legislation
 - (f) Confidentiality of information collected.
- (iii) **Objectives and nature of the census**
 - (a) What information is to be collected
 - (b) How the census is organized
 - (c) How the census is to be taken
 - (d) When sampling is being used, how the sample is selected.
- (iv) **The prescribed questionnaires and listing schedules**
 - (a) Concepts and definitions that are used
 - (b) Making entries on questionnaires
 - (c) Example of questionnaires already completed.
- (v) **Procedures to be followed**
 - (a) Making appointments
 - (b) From whom to obtain information
 - (c) Techniques for conducting a good interview
 - (d) Overcoming objections of holders to provide information
 - (e) Objective measurements (if any)
 - (f) Checking and editing questionnaires
 - (g) Call back to obtain missing information
 - (h) Ensure completion of coverage
 - (i) Use of interpreters.
- (vi) **Practical work**
 - (a) Visit an area in the neighbourhood
 - (b) Distribution of work among the enumerators
 - (c) Explaining their work to enumerators
 - (d) Actual completion of some questionnaires by the enumerators
 - (e) Measurement of areas and yields (if envisaged).
- (vii) **Editing**
 - (a) Discussion of filled-in questionnaires
 - (b) Explanation of concepts and definitions in light of experience in the field
 - (c) Explanation of job requirements of the enumerator
 - (d) Explanation of procedures to be followed in enumeration.

- (viii) **Examination**
 - (a) Quiz on the questionnaires
 - (b) Quiz on procedures.
- (ix) **Administrative instructions for enumerators**
 - (a) Hours of work; the need to conduct interviews outside normal office hours
 - (b) Absenteeism
 - (c) Allowances that would be paid and conditions attached to payment
 - (d) Enumerator requirements on administrative matters
 - (e) Required records on time and attendance
 - (f) Forms to be filled on completion of work.

Duration and content of supervisor training courses

12.18 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.

12.19 The training of supervisors will naturally take longer than the training of enumerators and should include field practice. The following subjects may be considered for inclusion in their training programme in addition to the subjects for enumerators.

- (i) **Supervisors' work**
 - (a) Their responsibility
 - (b) How to check maps of local areas and enumeration districts
 - (c) Preparation of lists of holders and how they are used and checked, using training guides.
- (ii) **Work dealing with enumerators**
 - (a) Action required to select and recruit enumerators
 - (b) How to conduct training sessions for enumerators
 - (c) How to observe the enumerator at work
 - (d) How to review and edit questionnaires and other records prepared by the enumerators
 - (e) How to measure the performance of enumerators
 - (f) How to handle cases of respondent refusal to provide required information
 - (g) How to handle special problems encountered by enumerators
 - (h) How to replace enumerators
 - (i) How to do a final review of enumerators' work.
- (iii) **Field work**
 - (a) Practical training in data collection and filling in questionnaires
 - (b) Organization of field editing and aggregation of completed questionnaires.
- (iv) **Quality control (if assigned)**
 - (a) Procedures
 - (b) Reporting
- (v) **Technical matters**
 - (a) Reading maps, identifying parcels
 - (b) Estimating fractional areas of parcels
 - (c) Identifying important crops

- (d) Local units used and their conversion to standard units of measure.
- (vi) **Other matters**
 - (a) Publicity
 - (b) Data processing.
- (vii) **Administrative instructions**
 - (a) Hours of work
 - (b) Absenteeism
 - (c) Administrative authority and responsibility
 - (d) Required attendance records
 - (e) Action to be taken when work is not satisfactorily completed.

Use of training aids

12.20 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.

12.21 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. Unfortunately, films are somewhat expensive to produce. Inter-country cooperation in this regard might perhaps be organized for producing a good film at a lower cost for every country.

12.22 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. 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.

12.23 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.

12.24 Overhead projectors and transparencies, and the blackboard, are also very effective training tools.

12.25 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.

Training in writing inspection reports

12.26 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. The aims of these reports are:

- (i) To inform the authorities of the work progress and its relation to the planned time schedule.
- (ii) To identify any deviations and problems in progress so that proper and timely action may be taken.

12.27 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.

Suggested reading

FAO (1965). Some problems of agricultural census taking with special reference to developing countries (by V.G. Panse).

UN (1992). Handbook of population and housing censuses: Part I, Planning, organization and administration of population and housing censuses. Studies in methods, Series F, No. 54.

CHAPTER 13

PRE-TEST SURVEYS AND PILOT CENSUSES

Pre-test surveys and pilot censuses are a critical part of the census planning process; they provide the opportunity to test all aspects of the census programme in advance of the main census activities, thus ensuring the smooth operation and success of the census.

Pilot surveys should test the census methodology (including the sample design in the case of a sample census), the questionnaires, data collection methods, the training programme for field staff, instruction manuals, data editing and coding, data processing and data tabulation.

The results of the pilot census should be processed to test the programs in the data processing system. A complete set of tables should be produced using the data from the pilot census to evaluate the tabulation programme.

The effort put into conducting a pilot census is wasted if results are not available in time for the efficient planning of the main census. Critical issues and problems encountered in field testing must be corrected well in advance of the start of the main census.

Suggestions for changes in the material tested, and in procedures and methods followed in the pilot census, should be included in the report(s), and will form the basis of the census operation. They should, therefore, be examined and evaluated by all authorities concerned with conducting the census. The national agricultural census committee should take into account all these suggestions before finalizing the operation of the main census.

Introduction

13.1 An agricultural census is a complex and expensive operation consisting of a series of closely related steps which must be planned carefully in advance. When census field work starts, all procedures, and documents such as questionnaires, 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 by carrying out a programme of pre-tests and a pilot census.

13.2 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 (see Chapter 18). 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. While the terminology relate specifically to a full-scale census, the pre-testing and pilot exercises are equally important in any statistical survey.

Pre-test surveys

13.3 Before planning a pilot census, the conduct of a series of pre-test surveys is highly desirable. The objective of the pre-test surveys should be confined mainly to the formulation of concepts and definitions, census questionnaires, instruction manuals, etc., and the evaluation of alternative methodologies and data collection techniques. Pre-test surveys differ from the pilot census in that they are usually relatively small-scale exercises and the selection of respondents is often not on a random basis. Instead, in a pilot census a good cross-section of respondents is chosen in a systematic manner with consideration being given to ease of enumeration and quality of response. 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.

13.4 The pre-test survey is particularly important for the formulation and wording of the questionnaires. This task 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. Obviously, such tests should be conducted under varying socio-agro-economic conditions and the results of the tests should be submitted to the national agricultural census committee (see Chapter 2). The report should give concrete and constructive suggestions on the revision of questionnaires, etc. 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.

The pilot census

13.5 The pilot census, unlike the pre-test surveys, is a 'dry run' for the main census but on a limited scale. It should evaluate all aspects of the census operation including the concepts and definitions, the adequacy of the questionnaires, the training of field enumerators and supervisory staff, field organization, census methodology, sampling design and estimation procedure, data processing and data tabulation. 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.

13.6 The timely organization of the pilot census is strongly recommended. Through pilot censuses facts are obtained and experience gained. Without the pilot census, activities are not based on facts and are more or less qualified judgements. Pilot censuses represent a means for achieving rational designs through which the objectives of the census can be accomplished. The decision to take one or more pilot censuses will depend on the agro-climatic and socio-economic conditions of the country. An important principle of the pilot census is the wide application of the design. The design must be prepared in such a way that it is possible to derive a large variety of conclusions. If the census is being conducted for the first time and is on the basis of a sample, the pilot census should be organized in such a way that it offers the possibility to estimate sampling errors for a number of alternative designs as well as to evaluate their cost. 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 not only to finalize the questionnaires, concepts and definitions, but also to provide adequate information for determining the resource requirements (budget, personnel, transport, etc.), method and mode of tabulation, timetable, various types of biases and errors likely to occur in field data, etc.

13.7 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 must be available well in advance of the start of the main census. The report should mention the main objectives, the sample design, and the various stages of planning and implementation of the project. Even though the results of the pilot census may not be meaningful, 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 (see Chapter 2) should take all these suggestions into account before finalizing the operation of the main census.

Concepts and definitions

13.8 The first step in planning a census is to develop appropriate concepts and definitions which should be communicated to the census enumerators for the collection of data. Although the work done in the past by the census organization, or similar work done elsewhere, can be the basis for the preparation of a preliminary draft of concepts and definitions, its application to actual conditions will need verification. These should be tested in pre-test surveys by census enumerators responsible for collecting the data in the main census. For example, in the agricultural census, the definitions of agricultural holding, agricultural production, holder, total area of the holding, tenure, area rented, land utilization, net area sown, current fallow, uncultivated and waste land, etc., should be formulated in such a way that they can easily be collected by the census enumerators. Since the tenure system and agricultural practices vary considerably from province to province, it may not always be possible to adopt uniform definitions for the whole country. However, every attempt should be made to do so, or develop these differences in such a way that they can be aggregated for national level estimates. Some explanation, which may vary from one province to the other, may be necessary. Any weaknesses in the concepts and definitions will affect the final results. Therefore, the census organization must include appropriate concepts and definitions developed through pre-tests (see Programme for the World Census of Agriculture 2000).

Estimating resource requirements

13.9 One of the main purposes of pre-test surveys and pilot censuses is to provide elements required for preparation of the census budget and work-plan (see Chapter 3). A fairly clear idea of what is needed should exist at a very early stage. Information is usually available from previous censuses. If the census is being organized for the first time, information from other surveys or other countries may be used. Such information should be improved based on actual field experience as soon as possible as precise data are required to prepare the work-plan and budget.

13.10 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 may be asked to record time taken to complete each field operation, such as preparation of list of holdings, contacting the holder, extracting the relevant information from the holder, etc. A critical analysis of time records will help census management staff 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.

13.11 Similarly, equipment requirements (transport equipment, equipment for objective measurements and cartography if applied, 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 (see Chapter 17).

Frame

13.12 An appropriate frame of the census enumeration units is a major key to the success of the census operation and is essential, whether it is a sample census or a complete enumeration census.

13.13 Because of cost considerations, there may be a temptation to use some kinds of frames already available or prepared for other purposes. For example, there may be an attempt in the agricultural census to use the frame of households prepared for a population census. It is logical and economical to take advantage of the existence of such information. However, the frame needed in an agricultural census may not be readily available from information provided by a population census. Pre-test surveys conducted on an adequate scale, covering the different situations, should provide some help in evaluating how the population census frame can be used. If a new frame is to be prepared the problems become much more complicated. In practically all cases, a list of the agricultural holdings will have to be prepared for each enumeration area (or each sample block in the case of sample enumeration). 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. Recognition of the boundaries of each enumeration area is often difficult. Enumerator mistakes usually create under-listing of units. Such under-recording will be more common in situations where the census is to be conducted on a sample basis with the primary sampling unit being the segment of area or a village. The demarcation of the boundary is more difficult in areas which have not been cadastrally surveyed. The problem may be similar in hilly and remote areas where households are scattered. Many such problems have been discussed in the chapter dealing with frames (see Chapter 6). All such difficulties should be solved through pre-test surveys or pilot censuses.

Questionnaire

13.14 A major source of error is improper wording of questions on the questionnaire due to persons responsible for designing the questionnaire not being sure of the meaning of various definitions and concepts used in the census programme. The questionnaire designers may assume that the holders know everything about the census. It is often not taken into account that holders belong to a different class or education level and may not be able to follow the vocabulary used in statistics. In cases where questions are ambiguous and are not explained to the respondent, errors can be made. A considerable amount of

discussion and experimentation is essential before the questionnaire content and wording is finalized (see Chapter 8).

13.15 A series of pre-tests should be organized after the draft questionnaire is ready. Holders should be used in the pilot census 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. The main objective of this test should be to finalize the concepts and definitions, 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, etc. It should be possible to finalize the various aspects of the questionnaire by interviewing a relatively small number of holders.

13.16 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.

13.17 Another part of testing questionnaires is ensuring their suitability for data processing. For this purpose, personnel responsible for data processing should be involved not only in preparation but also in testing the questionnaire in order to propose and evaluate different alternatives. Ideally, the instructions for data processing operations (data entry, coding, editing, etc.) should already be prepared in detail so that the suitability of the questionnaire for processing and the validity of a planned data processing operation can both be tested. It is also very important to measure the time required to enter data from an average questionnaire as this information is needed to plan the required number of data-entry stations and related staff. Often, data processing specialists indicate that they can process almost everything, but in practice it is very important to test their ability to organize timely and smooth processing.

13.18 As a final test of the questionnaire, a pilot census may be used to reproduce all conditions under which the census will be taken. In general, no special observers are used and only supervisors, as a part of their normal duties, will observe some interviews and give an assessment.

Training of enumerators and supervisors

13.19 Training will normally be in phases (see Chapter 12). In the first phase, the field supervisory staff responsible for the agricultural census operation and for conducting the training of the field enumerators will be trained. Since the supervisors are entrusted with the supervision of the field work of a large number of enumerators with different backgrounds, 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. Pilot censuses are an excellent opportunity to provide on-the-job training to all supervisory staff. After the pilot census it can be determined if the supervisors' training was effective and what changes have to be made before training enumerators.

Methods of data collection

13.20 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. In most developing countries holders do not keep records of their holding. They may not even know in definable units of measure the amount of land they operate, particularly in areas where cadastral records do not exist. Collecting data through an interview will have many limitations under such circumstances. Often, the holders have no quantitative concepts, and even if they do, many of the agricultural operations are such that the holders fail to recall accurate information and consequently errors are introduced into the census data. For example, agricultural labour is an item 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 holders will have to be developed and this will depend on understanding the socio-economic status of the holder. Pre-tests surveys should provide guidelines on the methodology to be adopted to collect data on different specific items.

13.21 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 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.

13.22 When the agricultural census is based on a sample, the results are subject to sampling errors. These errors can be minimized by employing an adequate sample size and a suitable sampling design. There are, however, other errors called non-sampling errors which affect all census results whether they are based on a complete enumeration or a sample. Many studies have shown that non-sampling errors can be quite serious, and can affect the results of the census to such an extent as to distort the picture of the agricultural situation presented by the agricultural census. Therefore, in planning and conducting the agricultural census, maximum attention needs to be paid to devise procedures for keeping non-sampling errors to a minimum and the additional cost incurred should be balanced against the increased reliability of the census results and their acceptance by users.

13.23 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.

13.24 It is more difficult to control the respondent's bias. In most 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.

Sampling design and sample size

13.25 When an agricultural census is to be carried out on a sample basis, the pilot census can test the efficiency of the sample design and provide guidance on the optimum sample size.

13.26 The determination of sample size is a complex problem (see Chapter 7). The census is basically a multi-purpose inquiry. Data are collected on a large number of characteristics of the agricultural holding. The size of the sample will largely depend on the objectives of the census and the accuracy of the estimates of the different desired characteristics as well as the level of geographic detail required. It is sometimes possible to make some rough estimates of the variability among statistical units, and therefore of the sample size, from past surveys and censuses. When past data are not available the pilot census should provide information on variability and cost of enumeration, and will provide appropriate guidelines for planning the main inquiry.

13.27 The sampling design often adopted for an agricultural survey is a stratified two-stage design with villages or area segments as primary sampling units and agricultural holdings as secondary sampling units. Field data from pre-tests or pilot surveys may be very useful to test possible stratification and decide the number of primary and secondary sampling units to be included in the sample. Based on field data, it is also possible to experiment with different methods of estimation, such as a ratio or regression method, to arrive at the best possible estimate with the available data.

Data processing

13.28 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.

13.29 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.

13.30 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.

13.31 Processing pilot census data provides an opportunity to test various commercial software packages against computer programs prepared in the house. Also, the tests can evaluate the efficient use of microcomputers against mainframe computers and the suitability of decentralized processing in provincial offices or by private contractors. Various procedures for checking data, data entry, manual and computer 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. 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.

CHAPTER 14

CENSUS ENUMERATION

Census enumeration 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 and surveys, such as sampling (see also Chapter 7), interviewing, etc. The period and duration of enumeration is also discussed. There are also references to specific problems, such as mixed cropping, continuous harvesting, shifting cultivation and nomadic livestock. 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 11), Training Programme (Chapter 12) and Organization of the Field Work (Chapter 15).

Introduction

14.1 The agricultural census operation consists of a series of closely-related activities which must be carefully planned in advance. It requires a well-coordinated organization from the planning stage to the dissemination stage. This operation must be able to handle the problems of statistical measurement of various characteristics of the agricultural holding, which is the unit of enumeration, and is generally considered to be much more complex than in other types of censuses and surveys. The agricultural census attempts to survey the entire agricultural economy of a country; therefore, the operation is particularly difficult for developing countries which have limited experience in organizing censuses and surveys. The census, as the name implies, is a collection of data for all individual agricultural holdings by direct enumeration. The economy of most developing countries is based on agriculture. These countries want to develop their agriculture rapidly using modern agricultural technology mostly generated in developed countries. To do so, requires detailed data on various characteristics of agricultural holdings.

14.2 Resource constraints are a major factor as each country considers whether the agricultural census is to be conducted as a complete enumeration or on a sample basis. Both methods have advantages and disadvantages. A census on the basis of a complete enumeration presupposes the existence of a certain minimum of facilities, such as funds, professional personnel for planning census methodology, sufficient number of qualified enumerators and supervisors, mapping material for the entire area to be covered by the census, data processing equipment, etc. All of these resources are not always available, especially in developing countries, with the result that a census on the basis of a complete enumeration cannot be conducted. However, a sample enumeration, even though it requires basically the same type of resources, requires fewer of them since the size of the operation can be much smaller. When making the decision to conduct a sample or a complete enumeration census, the advantages and disadvantages of both methods should be very carefully considered.

14.3 The application of sampling methods in an agricultural census and its advantages and disadvantages are discussed in Chapter 7. In this respect there are three main types of censuses to be considered:

- (i) **Complete enumeration** implies collection of data from all agricultural holdings. This is traditional, usually preferable, but is the most expensive method.
- (ii) **Sample enumeration** implies drawing a "representative" sample of holdings and collecting data from only these holdings. This method should be used when resources are limited and when using objective measurement techniques.
- (iii) **A combination of complete and sample enumeration** can be done in many different ways, such as the complete enumeration of large holdings and a sample enumeration of small holdings, or the collection of limited data by interview from all holdings and using sampling for area measurement, or for agricultural inputs, fertilizers, pesticides, machinery, etc.

Time reference

14.4 The items of investigation which usually refer to the whole year are: economic activities and production of the holding, employment in agriculture, aggregate area under crops, area of land irrigated, agricultural machines used on the holding, use of fertilizers and soil dressing, existence of wood and fishery production, etc. A different time reference may be used for some items, such as a week or a month for employment in agriculture.

14.5 Questions related to a specific date generally refer to information regarding the holding, holder, and tenure of holding; land utilization, number of trees or vines; number of livestock and poultry; demographic classification; number of permanent workers; area of land provided with irrigation facilities and drainage; stationary power-producing machinery, etc. When the area under crops refers to "on the date of enumeration" the time reference is a specific date. Some countries record some livestock products, such as milk, cheese, etc., with a time reference on a specific date. The specific date is usually considered the day of enumeration. In many countries there is more than one crop season during the year. Usually, one of these seasons is the major season. In such cases, the information on total area of holding, area under different forms of tenure, and area classified according to utilization should relate to a specific date in the major crop season. If the seasons are equally important then information on these items may relate to a specific date during the season nearest to the date of enumeration.

Duration and period of enumeration

14.6 Duration of enumeration refers to the time taken to conduct the census enumeration. In the case of a population census *de facto*, the entire operation is ideally completed in one day, at least in urban areas, and in just a few days in rural areas. This is not possible in the case of an agricultural census. Generally, the enumeration is spread over a longer period. The duration of enumeration depends on many factors, such as availability of qualified personnel to serve as enumerators, length of questionnaires, use of objective measurements, means of communication, climatic conditions, etc. There may be certain items of information in the census programme dealing with data which can be more reliable if collected in more than one round of surveys. Data on employment in agriculture usually relate to the week preceding the date of enumeration, i.e., the period of one week which ends on the day of enumeration. This information if collected only once will have limited value. On the other hand, if the question is asked about employment over the census year the information may seriously be affected by respondent memory lapse. The same is true of livestock products such as milk and cheese, especially for small producers who maintain no records. For such items of information the countries may prefer to collect data by means of successive sample surveys at different times during the agricultural year.

14.7 Generally, countries with well developed agricultural statistics include in the agricultural census only those items on which data can be collected in one visit for the whole year. Data requiring repeated visits such as employment, production, etc., are collected by specialized surveys. The period of enumeration for censuses of agriculture organized by different countries has varied from about a week to more than a year in case of repeat visits. Countries organizing only one enumeration round tend to complete the field work in one to two months. It is advisable to complete the enumeration in as short a period as possible.

14.8 The enumeration period refers to the specific time of year when census enumeration operations are under way. This time frame can greatly affect the accuracy of census results. It is desirable that the interval between the enumeration period and the reference date should be kept to a minimum to avoid memory lapses. In countries where data on harvested crop areas are collected by interview, and data on crop production are also collected, enumeration should be immediately after the harvest of principal crops when the holder can be expected to have the information readily available and more free time for the enumerator.

14.9 In countries with more than one cropping season, more than one visit is desirable, particularly if crop area is to be measured. Field area measurements for a season can be carried out soon after the sowing is completed, and the crop yield surveys can start as soon as the crop harvest begins. Generally, not more than two crop seasons are realized in most countries. The second phase, i.e., the crop yield survey of the first season, will then coincide with the field area measurements of the second season and the crop yield survey of the second season will be the third phase.

14.10 Data on livestock production are normally collected in specialized surveys by interviewing the holders on volume of livestock products, such as milk yield, which varies from season to season, and production of wool and mohair which are produced almost entirely within fixed shearing seasons. To minimize errors arising from memory lapses, information on such items should be obtained soon after completion of a season. For milk yield information, a visit to the holdings at the close of each quarter of the year will be desirable. One or two of the quarters can be made to coincide with the sheep and goat shearing seasons. These quarters can also coincide with the three phases of land use and crop area and yield surveys. Thus, enumeration aimed at collecting all these data can be divided into four phases. In each phase the data on employment characteristics can be collected for the previous quarter to measure seasonal labour input variability.

14.11 The agricultural calendar giving *inter alia* the sowing and harvesting seasons and peak periods of sale of crop production, and the production periods of the other agricultural products, is indispensable in determining the phases of the agricultural census and survey periods of different items in a particular phase. In many countries the agricultural calendar dominates the census planning and organization (e.g., some areas may not be accessible in the rainy season). Data collected on annual agricultural production surveys, farm management surveys and from extension services can be used to prepare an agricultural calendar. These calendars can also be used to control census operations (and to plan annual agricultural surveys) and their preparation should therefore receive priority.

14.12 It is important that the enumerators select a suitable time to interview the holders. During the day the holders are usually at work. Therefore, mornings or evenings are suggested as more suitable for interviewing. The enumerators cannot work only during fixed hours each day. They cannot necessarily choose Sundays as holidays. In many countries there are certain "market" days on which most of the holders go to the market place to make their sales and purchases and cannot be contacted at home. It is advisable that on such days the enumerators observe their days of rest. Such arrangements have to be in line with local situations. In some countries there are some provinces or areas which are

inaccessible during certain times of the year due to snow or floods, etc. The timing for enumerating these areas should be given priority over other areas.

Control of census operations and time schedule

14.13 In a country-wide operation like the agricultural census where staff are spread all over the country with a tight time schedule, it is of prime importance to devise ways and means for day-to-day control of operations so they are planned, organized and carried out methodically, correctly and according to a pre-determined time schedule. The need for an adequate number of supervisors and detailed guidelines for them and their training is discussed in Chapter 11. Designing a control chart for each phase or round of the census and a time schedule for enumerators and supervisors is most important.

14.14 For each phase of the census, a control chart giving the estimated date of commencement of an operation on any census item and the estimated period for its completion can be developed. The experience and knowledge gained in past censuses, and even in exploratory and pilot censuses, can be used to design and formulate the control chart. Against this control chart, the performance of each enumerator can be assessed.

14.15 In order for the control chart to be really effective, at the end of each day's work each enumerator should be required to record on a prescribed time-disposition schedule the work completed (see example in Frame 14.1). The content of this schedule can differ from country to country, phase to phase and month to month in the same phase, depending on the items of work to be covered in a phase or a month.

Country.....

Province.....

To be completed each day by the enumerator for the month of

Date	Morn- ing=M After- noon=A	Village where the enumerator worked	Name of enumer- ated holder(s)	N° of com- pleted quest.	N° of measured parcels	Yields measured (crop and N° of parcel)	OBSERVATIONS
1	2	3	4	5	6	7	8

Frame 14.1 Work Sheet

Methods of enumeration

14.16 The mail method of collecting data for a census is generally used in countries where the holders are educated and maintain accurate accounts of holding operations. However, data suffer from errors arising from non-response and biases inherent in a mail questionnaire method. Mail questionnaires can be used in a census of large modern holdings, settlements and irrigation schemes, and holdings under the control, supervision, guidance or management of government or public organizations and institutions for which records are maintained or can be maintained. For individual agricultural holdings, which are mostly small and subsistence in character, the census will have to be conducted by interview or inquiry method with the help of trained enumerators.

14.17 While actual measurements are desired and possible in respect of items such as land use, and crop areas and yields, information on items such as livestock numbers (and even livestock products if included under the census programme), machinery and equipment, holding population and employment, etc., will have to be collected by interviewing the holders. 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 in a programme of post-enumeration verification. 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.

14.18 Objective methods of area and yield measurements and physical verification can be applied where the census is conducted by trained enumerators. In the case of census by mail questionnaire, the respondents are expected to know the crop areas and production, and will frame their own estimates in which they can use measurements already taken, if any, of sales, ratios of quantity of seed planted to area planted, estimated average yield per unit, fertilizer and pesticide application rates, etc. 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.

14.19 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. There are different methods of actual field measurement such as rectangulation, triangulation and compass traversing. Rectangulation is recommended as the simplest if most of the fields are rectangular. Triangulation is a more universal method than rectangulation but requires walking inside the field. Compass traversing consists of measuring the length of the sides of a field and taking compass bearings. This is the most universal method, recommended by FAO, with the advantage of self-control through so-called closure error. This method requires the following equipment: measuring tape 20-50 metres, compass with $\frac{1}{2}$ degree precision, sometimes a clinometer for measuring slopes in mountainous areas and a programmable calculator to calculate the area (usually for use by supervisors). Whatever method is applied, actual field measurements are very 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.

14.20 Objective yield measurements are even more time-consuming and require a visit to the field at the time of the harvest.

14.21 The use of aerial photography for measuring areas of fields, although feasible, has a very limited application in agricultural censuses and surveys. Agricultural census data are collected from agricultural holdings and the use of aerial photographs implies that each field

of a holding covered by the census is identified by the enumerator and the holder on available photos. Aerial photographs are costly and create organizational complications to ensure that up-to-date photos are available at the time of the enumerator's visit. There may be distortions in size of fields on a photo due to difficulties in keeping horizontal flight at a constant altitude and due to uneven terrain. Use of remote sensing data for estimating field area is only possible for very large fields (such as those in the central parts of U.S.A. and Canada) but even then it is not normally used because of high costs.

14.22 The use of satellite data in the U.S.A. to improve sample estimates for crop areas is an important application of remote sensing. Considerable improvement has been achieved for some crops and, as a result, the sample size using satellite data could be cut by half to achieve the same precision. A new generation of satellites which produce better imagery are expected to increase the applicability of remote sensing in crop estimation work.

14.23 It should be mentioned that remote sensing has proved to be very useful for agricultural statistics for broad land use classification and particularly for construction of area sampling frames. Area sampling frames constructed using satellite imagery are considered to be superior to classical frames (list of villages) as they guarantee better coverage (fewer omissions and duplications) and do not require frequent updating. Although the area sampling frame is not important for complete enumeration censuses, it can be for sample surveys and is considered to be one of the most important applications of remote sensing in agricultural statistics. This subject is discussed in more detail in Chapters 5 and 6.

14.24 There are several important aspects of using remote sensing in land use statistics:

- (i) Remote sensing has the advantage over agricultural censuses and surveys as it covers all land territory while agricultural surveys cover only the area of the agricultural holding, which in some countries may exclude communal pastures, forests, etc.
- (ii) Remote sensing can provide data on broad land-use categories, such as cultivated land, pastures, forests, water areas, etc. Further breakdown of land use into crop types or other smaller categories of land use has not been successful.
- (iii) Data on broad land-use categories, when combined with an area sampling frame, are very useful to prepare an efficient sampling design for agricultural sample surveys.
- (iv) There are some conceptual problems of comparability of data on agricultural land use, as remote sensing relies on completely objective methods (biomass, etc.), while agricultural censuses and surveys use holders' concepts (forest grazing land is classified as forest or pastures according to its main use). Classification of remote sensing data requires "ground truth" which can be obtained from agricultural censuses or surveys.
- (v) Remote sensing is an independent source of land-use data which does not use the agricultural holding as a unit of enumeration and, apart from the consideration mentioned earlier, this application of remote sensing is not described in this publication.

14.25 Estimation of areas under different vegetables 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.

14.26 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, e.g., on 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. 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. 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 contents of the instruction manual was described in Chapter 11.

14.27 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 8), interviewers would skip all detailed questions for holdings with no livestock.

Some tips on interviewing

14.28 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 11 Instruction manuals and Chapter 12 Training programme about this method. Some organizational aspects will be described in Chapter 15 Organization of field work. This Section includes practical advice on interviewing respondents.

14.29 **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.

14.30 Ordinarily the enumerator would proceed as follows:

- (i) Identify himself by showing an official identification card.
- (ii) Explain the purpose and objectives of the census.
- (iii) Describe the method by which the respondent was selected, if sampling is used.

- (iv) State the confidential nature of the interview as provided by the census law.

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.

14.31 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.

14.32 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 a different order will affect the way they are answered. The enumerator should be aware of this and be instructed to adhere to the prescribed wording.

14.33 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.

14.34 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.

14.35 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.

14.36 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.

14.37 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.

Special problems of census enumeration

14.38 **Crops cultivated simultaneously:** This is one of the most difficult problems in agricultural statistics 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.

14.39 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.

14.40 Problems refer to situations when many crops grow together in thousands of different combinations. In such cases the census questionnaire allows space for two to six constituent crops (depending on the country). Experience has shown that at least four of the most important crops should be considered. Some important commercial crops, such as chili can be omitted as not being the most important crops in the field.

14.41 A relatively simple way of handling this situation is to classify each crop as a pure stand, principal (predominant, main) crop in a mixture, or as a secondary. In this way, total cultivated land can be calculated as the sum of pure stand and principal crops, without duplication. Production can be estimated if yields are known for each of the three crop classes.

14.42 Most countries with problems related to simultaneous crop cultivation use some kind of objective method to allocate a part of the field area to each constituent crop. The so-called imputed (theoretical) area is calculated as the equivalent of the pure stand area by using the density of plants or some other criteria (amount of seed, estimated production, etc.). The sum of imputed area may be larger than the physical area of the field indicating a beneficial interaction between constituent crops. The allocated area is calculated by adjusting the imputed area proportionately, so that the sum of allocated area is equal to the physical area of the field.

14.43 In the presentation and/or tabulation of these crop areas, it would be very useful to present the following four types of area separately for each particular crop:

- (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.

14.44 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.

14.45 **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.

14.46 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. 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.

14.47 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.

14.48 **Partial harvesting:** This refers to so-called "reserve crops" among which is cassava, a very important food crop in West Africa. 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 is the consumption and is very difficult to estimate.

14.49 **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.

14.50 **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.

14.51 **Enumeration of nomadic livestock** presents serious problems in some countries. Due to the scarcity of water or pasture lands or to other climatic conditions, the owners of

livestock are forced to move together with their livestock from place to place in search of suitable grazing conditions. These people may be divided into three classes:

- (i) The whole tribe is on the move with their livestock and they do not practise cultivation in any place. These are considered purely nomadic.
- (ii) The whole tribe is on the move with their livestock for the greater part of the year but practise cultivation for certain periods. These tribes are considered semi-nomadic.
- (iii) The third class comprises tribes where some members of the group are sedentary and engaged in cultivation or other economic activities, and a part of the group moves with the livestock as herdsmen.

14.52 The livestock of the second and third class of nomadic tribes mentioned above can be and should be enumerated where the tribes cultivate and should not present any serious problem. Enumeration of the livestock of the first category of tribes creates serious problems because of the difficulty arising from their continuous movements. These tribes generally follow well-defined periods of time and routes for their movements with the result that their location at a particular period of time is usually known to administrative authorities. For example, in Iran the nomadic tribes move to the plains of the south during winter and towards the mountains in the north during summer. They camp in tents outside villages. Each group has a fixed and well established route and period of time for their movement. This information can be obtained from the administrative authorities and used to prepare a list of the tribes, their subgroups and the approximate size which can serve as a frame. In some countries the enumerators travel with the nomadic tribe for the period required to collect census data.

14.53 An alternative frame to be considered is water points. This can be of some use if a complete list of all water points, such as water holes, wells, etc., with information of degree of permanency of each well and adequate maps indicating location of these points, is available. However, in this frame there will always be a problem of coverage, as it will exclude the younger animals which are kept and watered near the camping place, and those herds which are watered on rivers and other sources which are not on the list of water points.

14.54 Apart from the problem of contacting the owners of the nomadic livestock, there is the problem of their reluctance to provide information to census authorities. This problem may be solved to a considerable extent by including as enumerators veterinarians and others who associate with the people and are known to the tribesmen, such as sons and other relatives of their tribes.

14.55 **Shifting cultivation:** 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 short time and abandon them when the soil fertility is depleted. This system of cultivation is called "shifting cultivation".

14.56 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:

- (i) The area under crops during the reference period of the census, and
- (ii) The area prepared for cultivation but not sown or planted at the time of the enumeration.

14.57 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.

14.58 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.

14.59 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.

Supervision of field work

14.60 Supervision of field work, involving an element of surprise, in a sub-sample of holdings meets the twin objectives of keeping the enumerators on the alert and of assessing the nature and extent of errors being committed and of providing correction factors to the census results where found necessary. For the second objective to be achieved the supervisor has to record independently on prescribed forms (see example in Frame 14.2) the data on the questionnaires as actually found by him. More information concerning supervision is given in Chapters 11, 12 and 15.

Procedure for collecting and forwarding completed questionnaires

14.61 The supervisors should be directly involved in collecting the questionnaires from the enumerators and forwarding them to the census headquarters. They 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.

Country.....

Name of the enumerator

Province.....

.....
to be completed by the supervisor
(one sheet per enumerator)

Date of the supervision	Name of the village	Name of the holder	Number of verified parcels	Number of verified questionnaires	Difficulties met

Frame 14.2 Supervision Control Sheet

Suggested reading

Casley D.J. and Lury D.A. (1981). Data collection in developing countries. Clarendon Press, Oxford.

INSEE (1962). Manuel d'enquêteur agricole (Service de coopération)

FAO (1965). Estimation of areas in agricultural statistics.

FAO (1966). Quality of statistical data (by S.S. Zarkovich).

FAO (1982). Estimation of crop areas and yields in agricultural statistics.

FAO (1992). Collecting data on livestock.

Idaikkadar N.M. (1979). Agricultural statistics: A handbook for developing countries. Pergamon Press, Oxford.

UN (1992). Handbook of population and housing censuses: Part I, Planning, organization and administration of population and housing censuses. Studies in methods, Series F, No. 54.

UN (1982). Non-sampling errors in household surveys: Sources, assessment and control. NHSCP technical study.

CHAPTER 15

ORGANIZATION OF FIELD WORK

This chapter describes the need for strictly controlled and efficient field supervision. It should be kept in mind that the field supervisors are responsible in many countries not only for supervision of data collection but for selection, recruitment and training of enumerators, and in some cases for their remuneration. All such activities require control which cannot be provided directly from the central census office. The supervision structure has to be organized at provincial and lower levels. An efficient system of supervision is not easy to organize, considering that an agricultural census is conducted in many countries only once in ten years. The rehearsal of field organization procedures is made within the framework of a pilot census. Practical advice is also given concerning advantages of recruiting resident enumerators who are familiar with local conditions and local dialects.

A closely related topic is Census Enumeration covered in Chapter 14.

Department responsible

15.1 The primary and chief responsibility for planning, organizing, conducting and supervising the agricultural census operations, tabulating and analyzing the results, and preparing and publishing the reports normally rests with a single government department. Success depends on the support and assistance of other government departments and public agencies at various stages of the work. This cooperation is particularly important for field work and its supervision, including activities such as mapping and delineation of enumeration areas, seeking cooperation and support of the people through their leaders, training enumerators and supervisors, securing accommodation and other facilities for staff and transportation to the areas of operation, etc.

15.2 The department at the national headquarters responsible for the organization of field work on the agricultural census can be the statistics division or department in the Ministry of Agriculture or the Bureau of Statistics or Central Statistical Office located in the Ministry of Finance and/or Economic Planning. 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 there exists a central statistical organization in the country which is not only a coordinating body but also charged with the responsibility of organizing and conducting censuses and surveys.

15.3 The department responsible for organizing the agricultural census will seek the support and assistance of other departments, either in organizing the field work and enlisting the cooperation of the people or in developing plans and procedures, concepts, definitions and classifications. This support and assistance can be secured by the agricultural census committee (or coordinating board) at the national level with representatives of all departments concerned with the field organization and use of agricultural data. One of the major functions of this committee is to coordinate the activities of the staff of the different departments 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 committees (or coordinating boards) at provincial and district levels. The need to set up census committees at various levels of census operations has been discussed in detail in Chapter 2.

Provincial offices and their work

15.4 A large-scale agricultural census operation 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 forms, provision of necessary facilities and amenities, and payment of salaries, 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. It is necessary to establish census offices at the provincial and district levels. If the department responsible for the census organization already has provincial and district offices for normal statistical work and for survey and census purposes, these offices should be strengthened to deal with the increased work during the agricultural census or survey. The provincial offices for census and survey purposes should be located near other provincial government offices.

15.5 The provincial and district offices can serve as the secretariat and coordinating body for the census committees. These offices put the problems and difficulties faced in the field before the departments represented on the committees and obtain solutions, support and assistance. To enlist the support and cooperation of village leaders and the staff working on statistical operations, these offices can organize local meetings in which district administrators and officials of local administration and rural development departments can assist in educating people on the objectives and scope of the operation, its need and importance, its role in planning the country's agricultural development and people's welfare 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 more effectively by the provincial or district authorities. Often, more than one meeting of the leaders and their staff may have to be held before an agreement for support and cooperation is reached. The provincial and district offices have a necessary role to play in such situations.

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

15.7 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.

15.8 The supervision of field work, the prompt resolution of mistakes, the ability to keep staff working on location, 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.

Census field staff

15.9 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. Considerable time and resources will have to be spent in securing accommodation for them in rural areas, in providing them with the required equipment and facilities, in introducing them to village leaders and the people, and in securing cooperation. Some temporary enumerators will leave the job in the middle of the census operations and replacements will have to be found. These inconveniences can be avoided if normal field staff of the department responsible for the conduct of the agricultural census is supplemented by field staff of other departments concerned with agricultural statistics or agricultural extension.

15.10 Extension assistants or field officers of the Ministry of Agriculture who are usually 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, are a good source for enumerators. The census field operations and extension work can be integrated to complement each other. In most developing countries the number of extension agents is limited and their jurisdictions large. Moreover, extension activities cannot be postponed for a long period of time. In practice, only a part of the extension agents can usually be made available to assist in the census work. Experience in many countries would indicate that there may be more disadvantages than advantages in using extension workers for census data collection activities.

15.11 The advantages extension agents may have over temporary enumerators in census operations can be lost if they are moved to an area outside their jurisdiction. Moreover, the cost of the census operations will increase as extension agents will be paid for overnight stays outside their normal jurisdiction. Extension agents should not be allotted an enumeration area which does not fall within their normal jurisdiction.

General organization of field staff

15.12 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.

15.13 If staff with local knowledge are recruited, the enumerators can work alone in their jurisdiction as they will usually get cooperation from holders. If it is not possible to recruit qualified and experienced enumerators from the localities where they need to work, it may be preferable to allow enumerators to work in teams. This may be desirable in difficult areas with poor transport and communication facilities. Sometimes, for safety reasons it is better to have a team of enumerators.

15.14 The advantages are lost as teams become large. There can be some economy in transportation and provision of accommodation, camp equipment and facilities for the enumerators when organized in teams. 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.

15.15 The formation of teams of enumerators can also be useful when field staff of other departments are made available to supplement on a part-time basis the trained and experienced enumerators of the department responsible for organizing and conducting the census. Such part-time enumerators can be used in emergencies or when an adequate number of fully-trained enumerators are not available. It is highly preferable to rely on full-time and fully-trained enumerators.

15.16 In a team, enumerators are likely to duplicate 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. 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.

15.17 The crop harvests of one season may be at different times in different parts of a supervisory zone or district of the country, but usually the harvesting period in an area is a very limited time. The enumerators allotted to such an area may not be able to complete the crop-cutting survey on time if crop-cutting is necessary to estimate crop yields. In such situations, enumerators from other areas where the crop harvests have not started or have been completed, can be transferred to assist.

Supervisory work and staff

15.18 Adequate supervision of enumerators' work at proper times and at frequent intervals, both by routine procedure and by surprise visits, is essential and one of the most important organizational aspects for a successful operation. Cases have been reported in many countries where questionnaires were completed with false information without respondents being interviewed or with remote fields being omitted when the field areas had to be measured. Enumerators' problems and difficulties, and the guidance and assistance needed, will be known and the required help given if their work is inspected at regular intervals. Enumerators' work should be supervised at least once a week, more frequently in the initial stages of the work, and less frequently when the supervisor is convinced that the enumerators understand their work and do it systematically and correctly. The purpose of supervision should be to prevent carelessness and negligence by the enumerators and to impart instructions with reference to actual situations in the field, and also to solve day-to-day technical and operational problems.

15.19 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 actual measurements, observe their work closely and take immediate measures to correct any noticeable shortcomings. Supervisors should later visit and observe one or two interviews and check a sample of questionnaires to ensure their completeness, accuracy and consistency. As each phase of enumeration work in an area is completed, the supervisor should review the work and ensure that all households have been listed and questionnaires

have been fully completed for all agricultural holdings; and corrections made for any deficiencies observed before starting the next phase or moving to another area.

15.20 Supervision can be efficient and objective by checking a random sub-sample of enumeration areas and holdings. The supervisor's observations, along with the data entered by the enumerators, can be recorded on a prescribed supervision form. 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. Supervisors also have to arrange for accommodation facilities, the transport of forms and camping equipment for the enumerators from the headquarters or provincial offices, introduce enumerators to the people and brief the local people on census operations and encourage their cooperation. Considering the extent and nature of the responsibilities supervisors have to discharge in often difficult terrain, 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.

15.21 A supervisor can be expected to complete supervision of not more than five enumeration areas in a month. This should be taken into account when determining the size of the sub-sample for supervision.

15.22 For successful, timely and effective supervision, adequate transport is essential for both the supervisors and enumerators. Often, the supervisor is provided with a four-wheel-drive vehicle or a motorcycle, an enumerator with a bicycle. In some areas these are not suitable, and supervisors and enumerators may have to be authorized to hire local transport, such as horses, mules, camels, boats, etc., depending on what is available or needed to get the job done. Other details regarding supervision can be found in Chapters 11 and 12.

Enumeration work and staff

15.23 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 in the year and the terrain to be covered. In many developing countries which have only one major crop season or at the most two, the terrain is difficult, transport and communication limited and movement from one enumeration area to another time consuming. The households in an enumeration area may also be far apart. It is difficult to recommend the 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 (see Chapter 13). Perhaps the most important time factor is whether plans for objective measurements for areas and yields 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 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.

15.24 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 rural development officers. 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.

15.25 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 objective measurement of areas is required they can help in measuring distances and taking compass readings. They can hold poles at the corners of the fields, run the measuring wheel or chain and strings or frames for demarcating crop-cutting plots. 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.

15.26 These helpers can be paid either a daily or monthly wage based on the quantity of work done. The remuneration should be in line with wages paid in the past or for similar work. The enumerators should be given an allotment to cover such expected expenses.

General suggestions for preparing the interview

15.27 **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.

15.28 **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.

15.29 **If possible, appointments should be made in advance.** The date the census or survey will begin is often announced through publications and news 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.

Suggested reading

Casley D.J. and Lury D.A. (1981). Data collection in developing countries. Clarendon Press, Oxford.

FAO (1965). Estimation of areas in agricultural statistics.

FAO (1982). Estimation of crop areas and yields in agricultural statistics.

FAO (1992). Collecting data on livestock.

CHAPTER 16

QUALITY CHECKS AND POST-ENUMERATION SURVEYS

No matter how well a census or a survey is organized, it is difficult to assure that quality data is collected. It is very important to arrange various data checks before data are disseminated to the public. This chapter describes various methods of checking data quality, the most important of which is a post-enumeration survey. Often, such quality checks are not organized as this is one of the last census operations when funds are not available. Statisticians responsible for the organization of the censuses in many countries have not historically disseminated this kind of information.

This chapter deals with non-sampling errors while sampling errors are described in Chapter 7. 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. These errors usually refer to coverage errors (missing holdings, duplicates, etc.) and response errors. Even when systematic errors are detected, the correction of such data is difficult and is not recommended.

Introduction

16.1 In censuses and surveys it should be a practice to analyze the accuracy of data collected. Considering the large number of enumerators and supervisors employed, the number of steps involved in organization, difficulties in controlling operations, particularly in remote areas, it is also necessary to check the quality of data disseminated. The organizers should be aware of the quality of the data before they are released for public use; and data users should be aware of data limitations in order to avoid mistakes in decision making.

16.2 There are two types of errors in census and survey work:

- (i) **Sampling errors** occur when sampling is used. They refer to the discrepancies between the sample estimates and the population values that would be obtained by enumerating all units in the population. Sampling errors can be estimated and controlled in the sense that they can be reduced by enlarging the sample size.
- (ii) **Non-sampling errors** appear in all censuses and surveys. These errors refer to the discrepancies between data collected and their true value. They are due primarily to the variable performance of human beings and their lack of precise knowledge of the data requested. Strictly speaking, they are the result of mistakes committed in various phases of the census and survey work.

16.3 There are various methods of detecting and controlling data errors. Methods such as: (i) data evaluation as a part of supervision of field enumeration, and (ii) checking census tables against administrative or other available data may be called quality checks. A comprehensive check on a sample of raw data is recommended by FAO, and consists of a separate Post-Enumeration Survey (PES).

16.4 The purpose of this chapter is to discuss the various sources of non-sampling errors in agricultural censuses and surveys, and to describe methods for controlling such errors.

Sources of non-sampling errors

16.5 The non-sampling errors in census and survey data may be classified into three broad groups:

- (i) Errors resulting from preparatory activities.
- (ii) Errors committed in the data collection stage
- (iii) Processing and tabulation errors.

16.6 **Errors committed in the preparatory stage.** These errors are the direct responsibility of the census organizers, and are primarily due to insufficient pre-testing of various operations. They may be classified as biased tool and biased procedure errors.

16.7 Biased tools refer to means used for data collection such as: questionnaires, instruction manuals, tables of random numbers for selection of sample holdings, etc. Some definitions may not be adequate, or some concepts may be defined in a misleading way, so that the enumerator does not apply them correctly in the field work. The wording of some questions in the questionnaire may also be misleading, and instruction manuals may not be well drafted and, therefore, not clear to enumerators.

16.8 Biased procedures refer to measurement, sample selection and estimation procedures, etc. Concerning measurement procedures, it has been demonstrated that the objective measurement of yield does not always provide reliable data because of border and other biases. The sample selection procedure, when sample enumeration is applied, is a delicate operation which, particularly if entrusted to the field enumerators, may lead to considerable errors. Sample estimation procedures, if prepared by laymen, may also result in major errors in the census results.

16.9 **Data collection errors** are the responsibility of enumerators and respondents. They can be broken down into coverage errors, response errors, missing data, etc.

16.10 Coverage errors. 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.

16.11 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 units (units from which data are to be collected), some units 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 unit belongs to his/her segment. Such misjudgment naturally leads to errors.

16.12 Accuracy of coverage depends on the distribution of units over the area of the enumerator's segment. Congestion of units often causes trouble. In a situation of housing shortages, a number of holders might be found living in the same house sharing many of the common amenities, but operating 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.

16.13 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.

16.14 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.

16.15 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.

16.16 Response error is another serious error. Response errors are common in countries where holders do not keep records of their agricultural operations and do not have clear concepts of area measurement. Sometimes under-reporting is due to fear of taxation or imposition of land tenure changes. The nature of the inquiry may be cause for under-reporting. If holders do not keep records, it is difficult to get information on the number of trees in orchards. Under-reporting is also very common in reporting livestock numbers.

16.17 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.

16.18 The holders operating large holdings often 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.

16.19 Missing data is a special kind of response error. This refers to a variety of situations, such as when the holder is not at home during the period of enumeration. In case of crop-cutting, it may happen that the enumerator arrives after the field is already harvested. Refusals to report also represent missing data.

16.20 **Data processing errors** include those errors committed at the stage of data entry from questionnaire to computer media, either because of illegible handwriting or other reasons. Such errors are normally discovered by data entry verification or by computer checking for data consistency. As described in Chapter 17, the errors detected by the computer can be corrected either manually after comparison with the census questionnaire, or automatically by computer. The latter, however, is a very delicate procedure. Mistakes occur in handling questionnaires and/or corresponding computer records. Questionnaires may be misplaced, while computer records may have mistakes in identification codes. Errors in the data processing stage are easier to control than errors committed in the field, and can be avoided in a good organization. Nevertheless, routine controls such as checking for duplicate records, always discover unexpected mistakes.

Checking census tables against other data

16.21 The most common and often practised technique for checking the quality of data is the comparison of census totals with information available on the same item from independent sources. For example, data on crop acreage as collected in current surveys can often be successfully compared with the corresponding information available from the census. In India, crop and land utilization statistics are collected annually by complete enumeration employing the land record and revenue staff. These statistics can be compared with the corresponding statistics obtained through the census. This is possible only if the data collected in both cases uses the same definitions and concepts.

16.22 In many cases, there may not be comparable totals although there might be some possibility for evaluating sub-totals. In some countries a list of holdings of a certain size is maintained for the purpose of land taxation. If census data are tabulated in such a way that the holdings of such categories are separated, it might be possible to compare the administrative data with the results obtained in the census. Such comparisons are primarily used to study the effects of coverage errors and possibly other characteristics available in the record. Unless a group of holdings cover an important part of agriculture, such checks have limited value from the point of view of the population as a whole, unless each of the sub-totals can be checked separately for accuracy.

16.23 A similar technique which may be found useful is evaluating the consistency of data. The evaluation procedure aims at examining the consistency of data with other available knowledge which is generally accepted. For example, total area operated obtained in an agricultural census should always be less than the total geographical area. Similarly, the number of agricultural labourers obtained from the agricultural census should be less than the total rural labour force obtained through the population census. Such comparisons can only be very general, but they provide an opportunity to judge the quality of data. However, if such a comparison indicates that the data from the two sources differ significantly, these comparisons do not provide the tools needed to correct the census levels.

Supervision and post-enumeration check

16.24 The content of the PES should not normally be used as part of the supervision programme of the work and the supervisory staff should not be used to provide the necessary data needed for the PES. The existence of sample checks by the supervisor on enumerators' work is very useful as it represents some pressure on the census enumerator to do the work correctly. The procedure corresponds to application of statistical methods for controlling the quality of industrial production. The mere introduction of the quality control brings about a noticeable improvement in the quality. Supervision of enumerators should include as many unscheduled visits as possible. Supervision may be intensified in those areas where the work is found to be lacking or unsatisfactory. The census enumerators have different backgrounds and levels of training and experience. Some may be honest and intelligent while others may be indifferent, careless and dishonest. The supervision of the work of the latter category of enumerators should be more intensive. There may be some items in the census for which there are serious recording problems. Such items should be reviewed by supervisors very carefully. Consequently, census supervisors should not play the same role as the PES investigators. Therefore, the objective of supervision and the PES should not be confused. The purpose of supervision is to improve the quality of the enumerators' work, while the purpose of the PES is to make an independent assessment of the quality of data collected.

Purpose of the post-enumeration survey

16.25 The organization of PES on a sample basis is a common practice for evaluating the accuracy of data collected. In most countries, whether the census is based on a sample or on a complete enumeration, a PES is planned and conducted. The PES should be qualitatively better than the census, and its cost and size would be relatively small. 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.

16.26 The objective of the PES should be clearly outlined. The purpose will be to determine a quality measurement of the census data and to provide such information to users of the data. 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. 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.

16.27 The cost involved in organizing the PES discourages many developing countries from undertaking such a survey. 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.

16.28 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 surveys. 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.

16.29 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.

Design of the post-enumeration survey

16.30 The size of the sample and its distribution will depend on available resources for this purpose. A frame of enumeration blocks, which has been prepared for the main census, is a convenient frame for a PES. Considering the importance of coverage errors and the fact that the data on agricultural areas tend to be underestimated, the area frame for the PES should be independent from the frame used in the census, in order to better evaluate the census frame itself. A design which is likely to prove most useful for the PES should be based on area sampling, whenever possible, and particularly if the census was organized on the basis of a list frame (e.g., list of villages). Agricultural situations and levels of farming vary considerably from province to province, depending on the agro-climatic and socio-economic conditions. Errors in data collection, to a large extent, are impacted by the socio-economic situation of the holder. It is advisable to adopt agro-climatically and socio-

economically homogeneous zones as strata, with area segments or the village as the first stage sampling unit and an agricultural holding as the second stage sampling unit. The technique of "two stage sampling" can easily be adopted to collect data on some items from a larger sample of holdings and, at the same time, collect data on some other items from a smaller sample. For example, the listing of agricultural holdings can be checked for the entire sample selected for the PES, while the information on selected census data, such as crop area, agricultural inputs, livestock numbers, etc., can be obtained from a sub-sample of holdings. In its simplest form the PES would involve (i) selecting a sample of area units, such as enumeration blocks or villages; (ii) preparing a new list of agricultural holdings in the selected enumeration unit; (iii) collecting relevant data on selected items incorporated into the census programme from a sub-sample of holdings; and (iv) estimating separately the coverage bias and the response error.

Method of data collection in the post-enumeration survey

16.31 The PES should normally be a small sample survey carried out soon after the census enumeration is completed, utilizing qualified and trained enumerators. The questionnaires to be used by the PES enumerators should deal with only a few key items from the census. 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 objective and 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.

16.32 The field operations of the PES should start as soon as the census enumeration is completed. Re-enumeration during the census 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. Enumerators working on the PES should never be assigned the same area they worked during the census. 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.

Presentation of errors detected in the post-enumeration survey

16.33 Suggested methods of presentation of errors in census data will be described in this section, while the possible content of the report on the PES is given in Chapter 18.

16.34 PES errors may be classified into two categories: (i) coverage errors and (ii) response 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. For example, a considerable omission of small-holdings may slightly affect the magnitude of totals for most characteristics in the programme of the agricultural census. However, it is often found that smallholders concentrate on livestock and poultry for improving their income. In such situations, if there is a large-scale omission of smallholdings, there is a possibility of under-reporting livestock and poultry numbers.

16.35 There are many different ways to present coverage errors. The suggested presentation is shown in Table 16.1. The absolute numbers in this table refer to estimates for the population based on the sample expansion, while percentages refer to the ratio of data obtained from the post-enumeration surveys as true values (100 percent). All information is classified by broad categories of size of holdings as it is considered important to analyze coverage errors in relation to size of holdings. Obviously, the countries in which small or large holdings prevail may choose different size categories, or countries may relate coverage errors to other holding characteristics such as land tenure.

16.36 The information shown in the stub of the table refers to the following:

- (i) Holdings listed in the census.
- (ii) Holdings listed in the PES.
- (iii) Holdings listed in both the census and the PES (agreements).
- (iv) Holdings listed in the census and not in the PES (erroneously included). The totals in lines 3 and 4 should be equal to the figure in line 1.
- (v) Holdings listed in the PES and not in the census (erroneously excluded or omissions). The totals in lines 3 and 5 should be equal to the figure in line 2.
- (vi) Bias which is equal to the difference between lines 1 and 2, or 4 and 5.

16.37 For other important data, such as area of holdings, area under major crops, number of livestock etc., the effect of coverage error can be presented in a similar Table.

Table 16.1. Effect of coverage errors on the number of holdings

(example)

		Size classification of holdings (in ha)				
		Less than 1 ha	1 ha and less than 5	5 ha and less than 10	10 ha and over	Total
1. Census	Number	1100	500	100	50	1750
	Percent	110	111	111	104	110
2. Post-enumeration survey	Number	1000	450	90	48	1588
	Percent	100	100	100	100	100
3. Agreement	Number	900	420	85	48	1453
	Percent	90	93	94	100	91
4. Erroneously included	Number	200	80	15	2	297
	Percent	20	18	17	4	19
5. Erroneously excluded	Number	100	30	5	0	135
	Percent	10	7	6	0	9
6. Bias (difference)	Number	100	50	10	2	162
	Percent	10	11	11	4	10

16.38 The other major source of error in statistical surveys is response error. This kind of error can be presented independently from coverage error for various characteristics in a form similar to Table 16.2 with the stub as follows: 1. Census, 2. Post-enumeration survey and 3. Bias. This kind of error can be presented only for holdings covered by both the census and the PES (named "agreement" in Table 16.1).

16.39 The total error, i.e., total of coverage and response errors, can also be presented for various census data.

Table 16.2. Effect of response errors on the total area of holdings

		Size classification of holdings (in ha)				
		Less than 1 ha	1 ha and less than 5	5 ha and less than 10	10 ha and over	Total
1. Census	Area Percent					
2. Post-enumeration survey	Area Percent					
3. Bias (difference)	Area Percent					

16.40 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 surveys and censuses to ensure higher quality. Each statistician responsible for planning the agricultural census should know to what extent the coverage and measurement errors for various characteristics could be surveyed, and whether these errors can be overlooked without running the risk of major biases, etc. All such questions can be answered by analyzing the data in the tables described above.

Suggested reading

UN (1982). Non-sampling errors in household surveys: Sources, assessment and control. NHSCP technical study.

UN (1984). Handbook for household surveys (revised edition). Studies in Methods, Series F, No. 31.

UN (1992). Handbook of population and housing censuses: Part I, Planning, organization and administration of population and housing censuses. Studies in methods, Series F, No. 54.

US Bureau of the Census (1974). Standards for discussion and presentation of error in data. Technical paper No. 32. Washington DC.

CHAPTER 17

DATA PROCESSING

The information included in this chapter is intended primarily for senior statisticians responsible for the organization and management of agricultural census data processing. The detailed technical issues of computer data processing are considered to be beyond the scope of this manual and are therefore not included. Other relevant topics are the Census Questionnaire (Chapter 8) and the Tabulation Plan (Chapter 9).

Data processing relates to those activities normally undertaken during and after data collection. The data must be edited before they are summarized and published in tabular form. In many countries large numbers of questionnaires are collected and the processing is a lengthy and complex operation. Of course, it is not possible to utilize this data without checking, classifying and summarizing them.

This chapter discusses the concerns and issues which arise during an agricultural census for the various activities related to data processing. Owing to rapid improvements in data processing technology, it is especially difficult to make recommendations or even to generalise because prior experiences have little direct impact on activities and situations in today's agricultural census, and so this is not attempted. Instead, technical details on data processing can be found in specialized literature. FAO has published a booklet "Micro-computer-based data processing" (1987), illustrating how to use standard software packages like dBase, SAS, and Lotus in census applications; however, it should be read as a guide to processes and techniques rather than as a reference to specific hardware or software, as technology in this area is changing rapidly.

Prior experiences

17.1 The increased availability of computers in the 1970s and 1980s was expected to be of great assistance in rapidly producing accurate census results. In practice, many problems, objective and subjective, occurred, leading to major delays in data processing. Some of these problems related to frequent failures of early models of computer equipment, difficulties in maintenance, power failures, lack of qualified staff, etc.

17.2 Other problems concerned 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. Perhaps the most important of these problems relates to difficulties in communication between statisticians and computer experts who are not familiar with each other's work. Typically, statisticians would forward questionnaires to computer sections without sufficient guidance and instructions. Since errors arising during data collection become visible when tabulations are prepared, the blame for these errors has often been attributed to the data processing operation.

17.3 The rapid improvement in electronic data processing hardware and software creates some difficulties in realistic planning. The proper choice of appropriate hardware, whether personal computers or micro-, mini- or mainframe computers requires knowledgeable input. The use of optical readers for automatic data entry and hand-held computers for direct entry

by enumerators in the field, has not yet become practical for most agricultural statistical applications. On the other hand, progress achieved in the reliability of the hardware and the low cost of electronic data storage, plus increasing availability of suitable software and trained computer experts are expected to contribute to smoother data processing of agricultural censuses and surveys in the future. Because of these rapid changes in technology, FAO chooses not to recommend specific hardware or software, since today's optimum configuration will rapidly become out-dated.

17.4 It should be remembered that, with respect to data processing, the agricultural census will, in general, be a new experience, even if previous censuses were processed by computer. Technology has changed and little of the previous experience and know-how can be applied. Often, the persons involved in earlier censuses may now be involved in other activities and not be available for the current census. Many countries will have recent experience of processing population censuses and other large surveys and this should be used to develop data processing methods and procedures for the agricultural census.

Hardware

17.5 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, (ii) large amounts of data storage required although most data processing requires sequential access to data, (iii) relatively simple transactions, (iv) relatively large numbers of tables to be printed and (v) extensive use of raw data files which need to be on-line, if possible.

17.6 Basic hardware requirements consist, therefore, of many data entry stations (PCs, terminals or similar) and a relatively simple central processor. Arrangements should be made for regular backups of the data files and a security system of the storage devices must be maintained. Previously, magnetic tapes were used since they were relatively economical and satisfactory storage devices. Sequential processing of the data was most common, but now most processing also utilizes direct access methods (see Frame 17.1). These types of storage devices (usually hard disks) are more readily available and are more economical than in the past. Fast, high-resolution graphics printers capable of producing tables ready for distribution are also required.

17.7 Many developed countries take advantage of local area networks (LANs) for processing the census data (see Frame 17.2). However, 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.

When information is stored in a file, it is usually located in "records" in the order in which it is entered. This file can then be sorted on the basis of a specific piece of information (key), so that the user can quickly identify the proper record.

When software programs access records in a data file on the basis of the order stored, the process is called **sequential access**. Thus, the software must read the entire file to access the last record in the file. In this case the "order" of the records is physically and logically the same.

If the software programs can read directly any record in the file (based on the key), then this process is called **direct access**. In this case the "order" of the records is not the same, physically or logically.

The access method depends not only on the software, but also the hardware. Sequential access was the only method possible when data were stored on a tape, because the tape would need to be rewound or wound forward in order to allow "jumps" in the reading. Hard disk storage allows reading without winding and rewinding.

Frame 17.1 File Access Methods

17.8 In developing countries with frequent power failures, equipment ensuring a continuous and stable source of electricity is essential. An Uninterrupted Power Supply (UPS) is very important and relatively inexpensive not only to protect computer hardware but also to prevent loss of data or delays in data processing during power failures.

17.9 One of the major decisions is the choice between a mainframe computer, a mini-computer and micro-computers. The solution depends mainly on the organization of the work and the cost of the equipment. The fact that much data entry is involved, and only relatively simple processing, makes micro-computers suitable for this application. Furthermore, micro-computers are more flexible for subsequent uses (e.g., can be transferred to provincial offices) and may be easily used for other applications after the census.

17.10 When estimating the hardware requirements the most important factor to be kept in mind in agricultural censuses is 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 (terminals or micro-computers) required for this operation. This 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 stations will also depend on the time planned to complete the whole data entry operation. An example of such calculations is shown in Frame 17.3.

17.11 When estimating the required number of stations it should be kept in mind that many of them will be applied to other uses: verification of data entry (often 100 percent verification is done; see the section on data entry and verification later in this chapter), 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. On the other hand, the number of months required for data entry can be reduced by introducing additional shifts, overtime, etc.

LAN (local area network) is a communication link allowing computers ranging from micro-computers to mainframes, and most of the peripherals (printers, modems, etc.) to access each other (data, programs, etc.) bypassing hierarchical structures. LAN usually operates within one site (such as a central statistical office).

WAN (wide area network) is a communication link between different LANs, either on the same site or in different places or countries (such as central and provincial statistical offices).

Frame 17.2 LAN and WAN

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 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 ($N=100000$) 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.

Frame 17.3 Calculation of the Number of Data Entry Stations

Software

17.12 As explained in more detail in the following sections, the main task of software in census data processing is: (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) presentation of data for printing. In addition, increasing use of software for graphic presentation and mapping of census results has been observed in many countries. In the case of sample enumeration, data have to be expanded and software for calculating sampling errors is required.

17.13 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.

17.14 Some software packages which were considered state-of-the-art only one or two years ago are now considered obsolete because more current software packages take advantage of quicker, more accurate processing techniques which formerly required (and still do) large amounts of memory and storage space. The difference is that more computers have the necessary memory and storage space.

17.15 Moreover, in one year, with potential changes in the operating systems and in the integration of the software into a multi-task environment, different versions and/or different packages will replace the older ones. The user is confronted with an enormous task of trying to maintain the quality of data processing, while adjusting to the rapid changes in its appearance and application.

17.16 The use of procedure-oriented software has already reduced the burden of programmers in the development of modules for generic types of statistical processes, like averages, variances, regressions, analysis of variances, scatter plots, etc. In the future it will be possible to "talk" to the computer and to accomplish many of these simple tasks. However, it will still require proper syntax and format to convey the commands to the computer.

17.17 Given this wide range of hardware and software, and rapid progressive 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). Word processing files written in one package may not be readable in a different package unless the file is converted to the proper format. Data entered on a spreadsheet may not be readable by a statistics analysis package; data entered into one kind of database may not be readable by a spreadsheet or by another type of database software. Thus, it is usually preferable to use standard software which are maintained by the manufacturer and for which documentation is easy to find plus the experts with wide experience. Portability of data files is important, not only within the statistical office but also to be able to provide data in a computer readable form to external users (see Chapter 18).

17.18 The improvements in laser printers, including the possibility of printing colour graphics, have made it possible to use standard micro-computer software for many publications. In the near future, one can expect the cost of these printers to be reduced significantly and the resolution to be much better. One major advantage is that many special characters can be incorporated into reports and graphs. Of particular value is the capability to print reports in most languages. Of course, this capability is directly related to the use of these same characters in software commands and text and in corresponding screen images.

17.19 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 modern technology can expedite the processing and dissemination of agricultural census data.

Purpose of checking, editing and coding data

17.20 The effect of checking and/or 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 unrealistic values).

17.21 Editing involves revising or correcting the entries in the questionnaires. The need for revising recorded data occurs in cases of illegible editing by enumerators. It should be kept in mind that most of the "errors" detected during data entry occur because of illegible handwriting.

17.22 An important function of checking is to verify that completed questionnaires properly identify the holding as an agricultural holding meeting minimum requirements such as size of holding or livestock, or value of sales, as defined for a specific census.

17.23 Numerical codes now replace "words" with numbers as a means of condensing information to be stored. Thus, the words "spring wheat" are replaced by a number (usually 3 digits in most countries), reducing the number of characters used from 12 (including blanks) to 3, which reduces the possibility of mistyping (misspelling) the crop when information is keyed into the computer.

17.24 Data checking, editing and coding is considered to be the most difficult phase of data processing. Most first-time census planners/statisticians can prepare a reasonably good table, but have great difficulty with the organization of data management. It is recommended, therefore, that this phase be planned early so that computer programs and related procedures can be prepared and tested to ensure that the overall approach is realistic and functional.

Data processing activities

17.25 The main activities in data processing are as follows:

- (i) Monitoring and controlling of questionnaires.
- (ii) Checking (manual editing) and coding.
- (iii) Data entry and verification.
- (iv) Computer editing and coding.
- (v) Storage and security.
- (vi) Tabulation.
- (vii) Calculation of sampling error and additional data analysis.

17.26 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 statistical unit is important to reduce the possibilities of misunderstanding and to clarify any issues which arise.

17.27 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. However, with a provincial office system, 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.).

Monitoring and control of questionnaires

17.28 The agricultural census is a large operation usually involving thousands of questionnaires even if a small-scale sample enumeration is organized; in the case of complete enumeration in larger countries there may be millions of questionnaires. Obviously, 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.

17.29 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. For example, in sample enumeration, an important practical advantage of having a fixed number of respondents selected in the secondary sampling units is in the fact that the size of folders is generally the same.

Checking (manual editing) and coding

17.30 The main task of checking or manual editing in data processing is to detect omissions, inconsistencies and other obvious errors in the returns and to correct them before subsequent processing stages or at least to reduce the level of errors to acceptable limits. Faulty 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).

17.31 Manual editing should begin as 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. This procedure facilitates any necessary re-enumeration and has the advantage of utilizing personnel familiar with local conditions.

17.32 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.

17.33 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.

17.34 Coding refers to the operation where original information from the 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. The modern trend is either to enter the complete answer or to use fully precoded questionnaires and to leave the problem of local units to enumerators who are expected to enter in the questionnaires data ready for processing.

17.35 Furthermore, since manual editing is followed by computer editing, the two phases should be coordinated. 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, should be entrusted to computers rather than to manual editing.

17.36 As already mentioned, manual editing should be organized in the field as part of the supervisors' responsibility. Instructions for editing should be included in the supervisors' manual. It is important to prepare a detailed manual for central office editing, not only to give instructions to editing clerks who can be trained verbally, but for the benefit of other staff to describe exactly how the procedures are applied. For example, staff responsible for computer editing should know the exact rules for manual editing to avoid possible contradictions and the introduction of personal bias.

Data entry and verification

17.37 Data entry, which refers to transfer of data from questionnaires to the computer-readable media, is one of the greatest time and resource consuming phases of data processing.

17.38 This operation is normally done by data entry clerks who key in data from questionnaires to disks or tapes using keyboards of data entry stations (terminals, micro-computers or similar units). Work can be organized in different ways; all data for the questionnaire can be entered at the same time or the data can be entered section by section using data entry clerks specialized in the specific sections. The present trend is to enter data for the whole questionnaire at one time, using software which simulates parts of the questionnaire on the micro-computer monitor.

17.39 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. This matter will be discussed later in the section on computer editing and coding.

17.40 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. 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.

17.41 In the case of larger censuses, complete verification should be done at the beginning of data entry, 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.

Data entry alternatives

17.42 Data entry through a keyboard is a time-consuming operation subject to human error. 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: (i) optical character readers capable of reading numbers or letters written by hand on a strictly predetermined position on the questionnaire and (ii) optical mark readers which can recognize marks made by a special pencil on numbers or letters preprinted on very special questionnaires. These methods have been tried in many countries with relative success, but a general conclusion seems to be that they are not suitable for agricultural census and survey applications which involve large digit numbers. The conclusions from cost/benefit analyses advise against using these machines in developing countries. Nevertheless, among the infrequent cases reporting successful experiences with optical mark readers we found the 1983/84 agricultural census of Bangladesh and the 1990 agricultural census of Japan.

17.43 Another approach used to speed up data entry concerns the field use of hand-held computers instead of questionnaires (or in addition to) with data entry completed directly by the enumerators who then send the data file using a telephone modem to a computer in the central office. This method has been used for a number of applications but still does not appear to be suitable for agricultural statistics on a cost/benefit basis, even in developed countries. Technological advances in the near future may reverse this evaluation.

Computer editing and coding

17.44 Computer editing is checking the general credibility of the data by computer 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., yield is a hundred times higher than normal, age of the holder is less than 15 years); (iii) internal inconsistencies (e.g., wheat production reported but area not reported, pigs under 6 months plus pigs 6 months and over 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.

17.45 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 zones, in order to avoid repetition of required calculations by the computer. This approach is a classic approach normally not used any more with fast modern computers (or PCs).

17.46 Computer editing is in fact a continuation of manual editing with several differences. Firstly, computer editing is aimed at discovering not only errors in questionnaires, but also errors committed at the data entry stage. Secondly, computer editing has an important advantage in that the computer is not subject to human errors, that is, instructions given will be implemented repeatedly as written so that consistency will exist. Thirdly, the process of computer editing is much faster than manual editing and, although detected errors may require manual intervention, it can immediately and accurately insert imputations and reduce the workload.

17.47 It should also be noted that manual editing may have some advantages. For example, manual editing can identify 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.

17.48 It is important, therefore, to coordinate manual and computer editing so that advantages of each are fully utilized and, above all, that instructions given for the two kinds of editing are not contradictory. 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.

17.49 Computer editing can be done in two ways: (i) interactively at the data entry stage, or (ii) using batch processing after data entry, or some combination of both. Modern equipment and software facilitate checking during data entry and immediately provide error messages on the monitor 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 computer editing operation.

Imputation

17.50 Most 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.

17.51 Whichever method is used, data correction or imputation, it is a delicate procedure difficult to implement. Imputation (see Frame 17.4 for examples of two methods) can be done manually or automatically by computer. Generally, manual corrections are recommended for smaller surveys and sample enumeration, 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. 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,

"Cold deck" and "hot deck" are the names of two 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.

The "Hot deck" procedure consists of using data from a recently processed holding with similar characteristics instead of using data from pre-selected holdings.

"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 but is more difficult to define and requires more powerful computers.

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.

Frame 17.4 Methods of Imputation

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.

17.52 Some of the above problems can be avoided by using automatic computer correction. 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.

17.53 The philosophy of computer 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 six months and six 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.

Storage and security

17.54 Two levels of storage and security are required: first, at the questionnaire level, and second, at the level of data stored on computers. When data are collected, most countries emphasize the confidentiality of the responses. Thus, it is necessary to prevent unauthorized access to the data at each level. When data are entered into a computer or edited, the individuals involved should be aware of this requirement and of the penalties associated with disclosure. Passwords should be used to limit access to files and, at a certain stage, it may be worthwhile to encrypt the data so that unauthorized access does not permit direct reading of data. The failure to do so may impact on the credibility of the organization and lead to less accurate responses or even refusals in the future.

17.55 It is impossible to know when data are going to be destroyed unintentionally; natural disasters, fires, power failures, programming errors 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 and that, as the processing continues, changes in the data require new backup copies. 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 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.

Tabulation

17.56 The tabulation plan was described in Chapter 9. Tabulation is not only the main component of data processing but the tables produced are the most visible outcome of the whole census operation and the most used output. Nevertheless, all preparations (dummy tables, computer programs, etc.) must be completed and tested, and the data editing and corrections properly done before the tabulation can become a reality. 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 programs and retabulation at this stage can delay the final output considerably.

Calculation of sampling errors and other analysis

17.57 As pointed out in Chapter 9, Tabulation plan, the data collected by sample enumeration cannot be properly used and evaluated unless an indication of the sampling error is associated with values obtained. These calculations are usually simple to obtain with "statistical packages". However, one should be careful about calculating sampling errors without having a good knowledge of sampling.

17.58 The data can be prepared not only in table format, but also as a data file which can be distributed to the users (see also Chapter 18). In this case it is important to ensure the confidentiality of data; even if questionnaire-level data is needed and can be legally supplied, names and addresses of holders should not be provided to users.

Testing computer programmes

17.59 Considerable time is required to write computer programmes for error identification, automatic error correction (if applied), tabulation, calculation of sampling errors, etc., using available software. The computer programmes prepared should be tested, possibly with data from pretest surveys. 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.

17.60 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.

Suggested reading

FAO (1965). Sampling methods and censuses (by S.S. Zarkovich).

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 18

DISSEMINATION PROGRAMME

Providing data to users is the main purpose of an agricultural census. This can be done in several ways: by providing copies of census publications (or equivalent copies on diskettes), and by providing users computer access to summarized data, or to raw data files, for further analysis.

This chapter describes various census publications. These should be planned starting with a catalogue of publications and a timetable of release dates as a commitment to data users on the availability of data. In addition to providing data, the public should also be informed on the methodological aspects of the census, which may help in the interpretation of the data. The public should also be informed on the data quality based on the post-enumeration survey results, in order to assist them in the interpretation and use of data.

Other important aspects of the dissemination programme are the publicity for promotion of data use and the emphasis to be given to providing early priority data. The relevant topics are the Tabulation Plan (Chapter 9) and Post-enumeration Surveys (Chapter 16).

Introduction

18.1 The agricultural census is one of a countries' largest statistical undertakings. It is also a costly operation which finds its value in the wide range of data uses, not only for policy decision-making but also for private use and general knowledge, etc. Providing timely and accurate data is a matter of great importance. The dissemination process should be well organized and discussed with primary data users within the census committee, as mentioned in Chapter 2. Traditionally, the main access to results is offered through published reports. Nevertheless, new methods of dissemination exist which will undoubtedly be more readily available with the advance of new technologies. One of the duties of the unit responsible for dissemination of data is to make the best use of both traditional and new dissemination methods.

18.2 Although the tendency is to plan to provide a wide range of 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. Those responsible for the census 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.

18.3 Along with the preparation of a work plan for the various census operations, a work plan and a specific budget should also be prepared for the dissemination programme discussed in the following paragraphs.

Informing the users

18.4 The publicity campaign should have made people aware of the census. Even if the enumeration was conducted on the basis of a sample where only a small fraction of holders was contacted during the survey, other holders, not part of the sample, should be made

aware of the census through the publicity campaign referred to in Chapter 10, Census Publicity. The main purpose of the census publicity programme is to make people aware of the objectives and purposes of the census and to obtain their full cooperation during the field work. Once curiosity has been created in the public's mind, they are expecting and looking for census results. The general public may not fully comprehend the implications and use of the census results, but this is not true of the principal data users, such as agricultural planners, research workers, agro-industrialists, etc. The primary data users keenly await the publication of the census results.

18.5 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 and trends 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 or television by the Minister of Agriculture or Planning (depending who is in charge of the census organization).

18.6 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 provoking interest for census data. This should be considered as an important part of the dissemination process by those associated with the census.

18.7 The publicity for promoting the use of census results should take into account that the primary users are:

- (i) Officials of the national government involved in planning, policy, programme evaluation, etc.
- (ii) Officials of local governments (interested particularly in detailed data for small areas).
- (iii) Agencies involved in current agricultural and rural surveys.
- (iv) International organizations such as FAO, World Bank, etc., concerned with development planning (very important users in developing countries).
- (v) Business and research organizations.

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.

The publication plan

18.8 The first document to be prepared should be a catalogue designed to present the publication plan, the date of issue of each report, 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 publication programme is finalized, and then widely distributed, particularly during the campaign mentioned above. The computer media releases may also be announced as part of the report. These would include raw data, additional tabulations, etc., on diskettes, compact discs, or direct access, as discussed later in the section on other kinds of dissemination. The catalogue is an official

commitment of the unit in charge of dissemination and a maximum effort should be made to meet this commitment.

18.9 The publication plan described in the catalogue may include the following documents:

- (i) Preliminary results (report)
- (ii) Final report (general)
- (iii) Atlas
- (iv) Technical report
- (v) Report on quality checks and post enumeration surveys

The nature and content of these documents are described below:

Preliminary results (report)

18.10 A short preliminary report with advance results should be issued as soon as possible. It may include only selected priority results, mentioned in Chapter 9, showing only totals without cross-classification, and may be only a few pages, usually at national and major administrative division levels. However, 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.

18.11 To maximize the benefits of the census, the results can be published sequentially. There are certain items of information, such as number of agricultural holdings according to their size, land use, area and production of major crops, number of livestock and poultry, etc., which are very important to agricultural planners and administrators, which should be published as early as possible. The importance of the items will vary from country to country, and, therefore, they should be chosen for advance tabulation in consultation with the Agricultural Census Committee. Because of the time factor it may not always be possible to prepare advance estimates of principal characteristics of the holdings based on all the holdings enumerated in the census. In this case a sample of holdings may be chosen for this purpose and the results released for the country as a whole or for broad administrative areas. The users of such results should be cautioned that such data is preliminary and subject to various sampling errors.

18.12 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 as a footnote so the user is aware of these limitations when using them.

18.13 One way of advancing the release date of census results is the direct reproduction of computer printouts. However, this technique 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 word processing or similar software which makes possible final improvements of the table lay-out and last-minute data changes.

18.14 An efficient process for developing quick advanced results is for field supervisors to 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 with totals calculated manually using a simple calculator. Higher-level supervisors should make aggregates for their areas. This procedure can also be applied in the case of sample enumeration, depending on the sample design. Usually it is sufficient to multiply village totals by respective expansion factors. It should be recognized, however, that this manual process is very prone to errors.

18.15 The period for releasing the advance estimates after completion of the field work will be different for each country. It will depend on the strength of the technical personnel and the data processing equipment that is available. However, the period should not be more 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 second publicity campaign promoting the use of the census results, described above, should not be implemented before important results are available.

18.16 The majority of users usually 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. This should not, however, deter from making such an advance release of preliminary results.

Final report

18.17 A general and final report of the census results should be prepared by the 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 a geographical basis, one volume for each province or, on a subject basis, one volume for land use, another for livestock, another for equipment, etc. The report should not be burdened with technical details but, in addition to numerous statistical tables, it should include information on conceptual, organizational and administrative aspects of the census which might be useful for better understanding and evaluating the data.

18.18 Thus, the final report could deal with the following items:

GENERAL PART

- (i) Objectives of the census
- (ii) Historical background. A brief history of previous censuses and current surveys.
- (iii) Description of the country. Its geographical area, population, agricultural zones, importance of agriculture and relationship of agriculture with other sectors of the economy.
- (iv) Geographical coverage
- (v) Methodology and organization. A short summary.
- (vi) Main concepts and definitions
- (vii) Census date and reference periods

RESULTS

- (ix) Summary of results. Important results will be summarized highlighting the salient features.
- (x) Explanations for use of tables (if any).
- (xi) Basic tables (described in Chapter 9 Tabulation plan).

ANNEXES

Some annexes such as census law, questionnaire, instructions, maps, etc., will be included.

18.19 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.

18.20 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 localities. This becomes a major issue in large countries. In India, for example, 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.

18.21 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 followed and the plans to disseminate data. 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 time and money.

18.22 In Chapter 16, Quality checks and post-enumeration surveys, it has been mentioned that the census methodology which obtains information on some of the items through interview might not be appropriate and the results should emphasize the census methodology used and, thereby, the limitation of the results. This is considered very important, particularly in developing countries as they have few traditions of conducting censuses. It is difficult to suggest an appropriate method of presenting results when it is known that they are subject to significant non-sampling errors. These will depend on the nature of the results and experience of the country. In extreme cases it might be advisable to present the results in percentages rather than in absolute figures. For example, if it is known that there has been an under-enumeration of total holdings for some reason, it will be better to present the number of holdings in different size classes as a percentage of the total number of holdings rather than presenting them in absolute figures. This technique of presenting results will be useful in many situations when the reliability of census results has not been fully evaluated.

Atlas

18.23 With the current progress in graphic presentation of data, through the use of computers, 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, etc., can be shown for different administrative (or other) areas on a map using different colours or shades. With modern equipment, production of such maps is simple once the delineation of administrative areas is stored on computer media. Of course, such an atlas can be part of the final report, but because of different (more expensive) printing, and different users (implying possibly a different number of copies required) it may be preferable to publish the atlas separately.

18.24 In some cases there may be limitations in applicability of mapping due to the data collection statistical methodology. As data are shown on maps by administrative (or other) areas in the sense that one area receives one colour or shade, the implication is that sample enumeration data for small areas are not reliable and cannot be shown as estimates. Even in a complete enumeration census, there may be a problem in countries with many large holdings spread across several areas, as data for small areas may not be representative. This means that data on large holdings are attributed in many countries to the area where holders live, maybe in a town, distorting the information on small administrative areas.

Technical report

18.25 A technical report is aimed at describing in detail how the whole operation has been conducted, the methodology, choices made, concepts and definitions applied, difficulties encountered, possible delays and their reasons, etc., and to use this evaluation for making recommendations for future tasks. A technical report should include an evaluation of problems met, mistakes made and solutions found, and may include many confidential elements. Furthermore, the main purpose is to record past experiences for future internal use; consequently, it may be preferable not to publish 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.

18.26 The following guidelines are suggested for preparing this technical report.

18.26.1 **Introduction.** This should give a complete overview of the census, lessons learned, if any, from previous surveys and censuses, and data gaps filled.

18.26.2 **Approach to census methodology.** This should describe the principal factors affecting the methodology of the census, types and details of data required by users, response from holders, availability of personnel, means of transport and communications, funds, administrative structure, agricultural practices in the country, current agricultural statistics and their relationship with the census, etc.

18.26.3 **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 blocks and preparation of maps; preparation of frame; and training of personnel.

18.26.4 **Field-work.** This may explain the methodology adopted in the collection of data such as mail inquiry, self-enumeration, interview, measurements, 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.

18.26.5 Use of sampling methods. 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 surveys, 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.

18.26.6 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 micro-computers, use of inter-active editing, new methods applied, use of resources external to the census office, etc.

18.26.7 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.

18.27 In countries which have achieved a sufficient level of statistical development and of 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 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. It is important to have a continuous recording of important points of the various phases of the census, including the problems and decisions made from time to time to enable the census staff to prepare the report. It should also be added that 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.

Report on quality checks and post-enumeration surveys

18.28 The need for quality checks and post-enumeration surveys has been emphasized in Chapter 16. Quality checks should be a post-enumeration survey. The work involved should be carried out and finalized immediately after the census is taken. Therefore, it will require special effort to finalize the analysis of quality check survey data in time to permit incorporating the findings in the census reports and in the technical report on census methodology. The report of the quality check survey should be included in the technical

report on census methodology. It is not recommended to modify census results based on findings from the quality check survey but it should be regarded as a means of evaluating the validity of the data collected, i.e., either to confirm their validity or to present to users the limitation of the data.

18.29 The report on quality checks can also be presented in two parts. The first general part, in addition to presenting data collected, may deal with the design of the quality check; supporting evidence (regarding the quality of data collected in the check); description of tables presented; interpretation of data and their use; and conclusion. The second technical part may contain sections on the purpose of the check; sample, its selection, efficiency studies; method of collection of data; organization of the check; supporting evidence on quality of check data; analysis of errors and biases; suggestions for improvement; problems needing further study; efficiency considerations; and suggestions for the improvement of future quality checks. The appendix to the report might contain the questionnaire, field instructions, instructions for measurement, etc.

Other kinds of dissemination

18.30 With full computerization of census data processing and advances in information technology there is an increasing interest in providing access to census data via computer media rather than providing tables on paper. Changes occur mainly under the following aspects:

- 18.30.1 **New support of information:** computer media products are offered to users usually against payment, in addition to traditional census publications containing census results. There are diskettes or compact disks (CD-ROM) able to store copies of census publications, more detailed cross-classifications (three or four-way classifications), census tables for small areas and further data analyses. This includes the possibilities of providing to interested users, such as local governments, cross-classifications obtained in the course of aggregation during data processing but not published for small areas, as well as additional cross-tabulations not envisaged in basic tables (see Chapter 9). Diskettes and compact disks have the advantages of being cheaper than publications, less bulky for transport and storage, and when necessary, the required pages can be printed by the user. Furthermore, since data are available in computer readable form they can be used for further analysis without the need to enter them again, providing suitable software is available.
- 18.30.2 **New ways of getting to information:** the availability of powerful micro-computers equipped with facilities to be connected with various data banks and information systems via telephone lines, using modems, offers numerous possibilities for increasing the use of census data through access to various pools of data. This application involves the availability of suitable software which includes information on data dictionary, record lay-out, etc. Similarly, particularly in the case of smaller countries, copies of raw data (or a subset) can be made available through these new accesses. In this case steps may have to be taken to safeguard confidentiality of data, particularly when raw data are made available to external users.
- 18.30.3 **New methods of data analysis:** with enormous progress made in the area of computer hardware and software, particularly referring to processing speed, storage facilities and graphic presentation, the dissemination of maps begins a new era. This application is related increasingly, in many countries,

to a Geographic Information System (GIS) being developed to collect, store and display spatial data from different disciplines. As already mentioned, the agricultural census data can be provided for the smallest administrative units in case of a complete enumeration census, or for larger administrative units only, in case of a sample enumeration, depending on the size of the sample. There are obvious advantages to planners and other users of census data in being able to take into account the spatial factor when studying agricultural data. To take advantage of GIS systems, it is advisable to georeference data at the lowest level, and if possible at the farm level.

Suggested reading

UN (1984). Handbook for household surveys (revised edition). Studies in Methods, Series F, No. 31.

UN (1992). Handbook of population and housing censuses: Part I, Planning, organization and administration of population and housing censuses. Studies in methods, Series F, No. 54.

US Bureau of the Census (1974). Standards for discussion and presentation of error in data. Technical paper No. 32. Washington DC.

GLOSSARY

Agricultural census (or census of agriculture) can be defined as a large-scale, periodic, statistical operation for the collection of quantitative information on the structure of agriculture. The word "census" implies a complete enumeration of all agricultural holdings. However, by extension it can be conducted by a sample enumeration, provided the sample is large enough to generate sub-national data (see the "Programme for the World Census of Agriculture 2000").

Agricultural holding (or holding) is an economic unit of agricultural production under single management comprising all livestock kept and all land used wholly or partly for agricultural production purposes, without regard to title, legal form, or size. Single management may be exercised by an individual or household, jointly by two or more individuals or households, by a clan or tribe, or by a juridical person such as a corporation, cooperative or government agency. The holding's land may consist of one or more parcels, located in one or more separate areas or in one or more territorial or administrative divisions, providing the parcels share the same production means utilized by the holding, such as labour, farm buildings, machinery or draught animals. The requirement of sharing the same production means utilized by the holding, such as labour, farm buildings, machinery or draught animals should be fulfilled to a degree to justify the consideration of various parcels as components of one economic unit.

Area frame is a sampling frame wherein the sampling units are portions of land, called segments (see Chapters 6 and 7).

Area measurement refers to the operation of measuring the size of fields (i) on the ground, using measuring tapes and other instruments such as compass, clinometer, etc. or (ii) using remote sensing (aerial or satellite) images.

Census committee is an inter-ministerial or inter-agency committee consisting of high-level personnel with main responsibilities consisting of the overall planning and direction of the census, in cooperation with and/or subject to the review of the census coordinator (see Chapters 2 and 4).

Confidentiality refers to the legal obligation of the census staff not to reveal the individual holding data to anyone, neither in the form of raw data nor in the form of tables which may permit disclosure of data for individual holdings. Obligation to respond is often linked to and legitimized by confidentiality as a guarantee for the respondent (see Chapter 1).

Continuous harvesting refers to crops which are harvested continuously throughout the season, such as carrots radishes, sweet potatoes, etc., or crops which are standing in the field more than a year, like sugar cane. The estimation of their production has to include all the harvest during the year (see Chapter 14).

Coverage describes the universe of units to be enumerated; it can include rural and urban areas. Under predefined thresholds, in physical terms or in value, very small holdings may be excluded from the census.

Crops cultivated simultaneously refers to the practice of cultivating two or more different crops simultaneously on the same field or plot. If crops grown simultaneously are temporary and permanent crops together, they are called crops grown in association. Otherwise they are referred to as mixed crops (see Chapter 14).

Data coding refers to the operation where original information from the questionnaire, as recorded by enumerators, is replaced by a numeric 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. The modern trend is either to enter the complete answer or to use precoded questionnaires and leave the problem of local units to enumerators who are expected to enter in the questionnaires data ready for processing (see Chapter 17).

Data editing refers to checking (manually or by computer) the general credibility of the 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. yield is hundred times higher than normal, etc.) (see Chapter 17).

Frame is the universe, or a list, of all units or elements for which data are to be collected. For the purpose of agricultural censuses and surveys the frame may be defined as a list of all agricultural holdings (see Chapter 7).

Hardware in respect to computers refers to the machinery such as central processing unit, disk storage, printers, etc., as opposed to the programs (software) that are written for its use (see Chapter 17).

Hired manager is a civil or juridical person who takes technical and administrative responsibility to manage a holding on a holder's behalf. Responsibilities are limited to making day-to-day decisions to operate the holding, including managing and supervising hired labour. Wages may be paid in cash and/or kind. A hired manager who shares economic and financial responsibilities, in addition to managing the holding, should be considered a holder or a joint holder.

Holder is a civil or juridical person who makes major decisions regarding resource use and exercises management control over the agricultural operation. The holder has technical and economic responsibility for the holding and may undertake all responsibilities directly or delegate responsibilities related to day-to-day work management to a hired manager.

Holding: see agricultural holding.

Household concept is based on the arrangements made by persons, individually or in groups, for providing themselves with food or other essentials for living. A household may be either (a) a one-person household, i.e., a person who makes provision for his or her own food or other essentials for living without combining with any other person to form part of a multi-person household, or (b) a multi-person household, i.e., a group of two or more persons living together who make common provision for food or other essentials for living. The persons in the group may pool their incomes and have a common budget to a greater or lesser extent; they may be related or unrelated persons or a combination of both. Households usually occupy the whole, part of, or more than one housing unit but they may also be found living in camps, boarding houses or hotels or as administrative personnel in institutions, or they may be homeless. Households consisting of extended families that make common provision for food or of potentially separate households with a common head, resulting from polygamous unions, or households with vacation or other second homes may occupy more than one housing unit.

Imputation is a term used in data processing indicating replacement of individual data which are either not consistent or missing (see Chapter 17).

Land use in agricultural statistics refers to land classification according to the agricultural holders' concepts of use i.e., arable land, pastures, etc. (see the "Programme for the World Census of Agriculture 2000" for detailed classification).

List frame in agricultural statistics consists of a list of villages or enumeration blocks and a list of names of agricultural holders with information required for locating them for the purpose of enumeration (see Chapter 7).

Livestock are animals such as cattle and sheep which are kept on the holding or otherwise for agricultural production (see the "Programme for the World Census of Agriculture 2000").

Nomadic livestock refers to animals kept by households with no permanent place of residence who are forced by natural circumstances, such as scarcity of water and pastures, or because of climatic conditions to move from place to place. The enumeration of such holdings presents special problems (see Chapter 14).

Pilot census is a "dry run" for the main census but on a limited scale. It is aimed to evaluate all aspects of the census operation. It usually takes place some months before the census (see Chapter 13).

Post-enumeration survey is a small-scale survey aimed at evaluating the accuracy of the data collected during the census. It provides valuable information for dissemination (see Chapter 16).

Pre-tests are usually small-scale exercises for evaluating specific aspects of the census during the preparatory phase (see Chapter 13).

Primary sampling unit is the first level of sub-division of the population, created by selection of a part of the population for further sub-sampling. These may be villages or area blocks which may be sub-divided into segments (see Chapters 6 and 7).

Publicity is the means of informing the public of the purpose of the census and ensuring cooperation of the holders during the enumeration process. All kinds of media may be used for the publicity campaign (see Chapter 10).

Questionnaire is the document used by the enumerators for recording the data. Its design is one of the most important operations of the census process (see Chapter 8).

Raw data are data on the questionnaire provided by the respondent or measured by the enumerator; such data are not yet reviewed or processed or ready for use. They are normally treated as confidential.

Sampling frame can be defined as a list of sample units that: (a) includes all (100%) of the population of interest without duplication, (b) provides a clear cut means of identifying each sample unit, and (c) arranges these characteristics so that probability sampling can be done efficiently (see Chapters 6 and 7).

Sampling unit represents elements or groups of elements of the universe under study, which can be selected in the sample. There may be sampling units of different levels (see: primary and secondary sampling units), the lowest level being the element under study, i.e., agricultural holding (see Chapter 6).

Satellite imagery describes the images provided by satellites (SPOT, LANDSAT...) and sometimes used for the cartographic preparation (see Chapter 5).

Scope refers to the list of items for which data is to be collected.

Secondary sampling unit is the second level sub-division of the population (ultimate level in the case of two-stage sampling) which may be agricultural holdings or area segments, intended for sub-sampling (see Chapter 6).

Shifting cultivation is a land utilization method; a particular piece of land is cultivated for some years and then abandoned for a period required to restore its fertility by natural vegetative growth; it is then cultivated again. The distinguishing feature of shifting cultivation is that neither organic fertilizers nor manure are used to retain soil fertility (see Chapter 14).

Software consists of programs that control a computer and its peripherals as opposed to actual machinery (see Chapter 17).

Stratification refers to a subdivision of the universe under study into homogeneous areas for sampling purposes, called strata. In each stratum separate samples are taken and separate estimates are made (see Chapter 6).

Time reference is a point in time or a period of time to which the data collected refer. A point of time may be either a specific date or day of enumeration. A period is used for reporting the activities, such as employment or production, and refers usually to an agricultural year (see the "Programme for the World Census of Agriculture 2000" for time reference of individual census items).

Tract is a portion or a sub-division of land which is under single management. It is either a whole holding, an agricultural or non-agricultural part of a holding. Tract is determined, therefore, by definition of a holding and by boundaries of a segment. A holding is composed of one or more tracts (see Chapter 6).

Workplan is a chart identifying all specific activities of the census in a time frame (see Chapter 3).

