

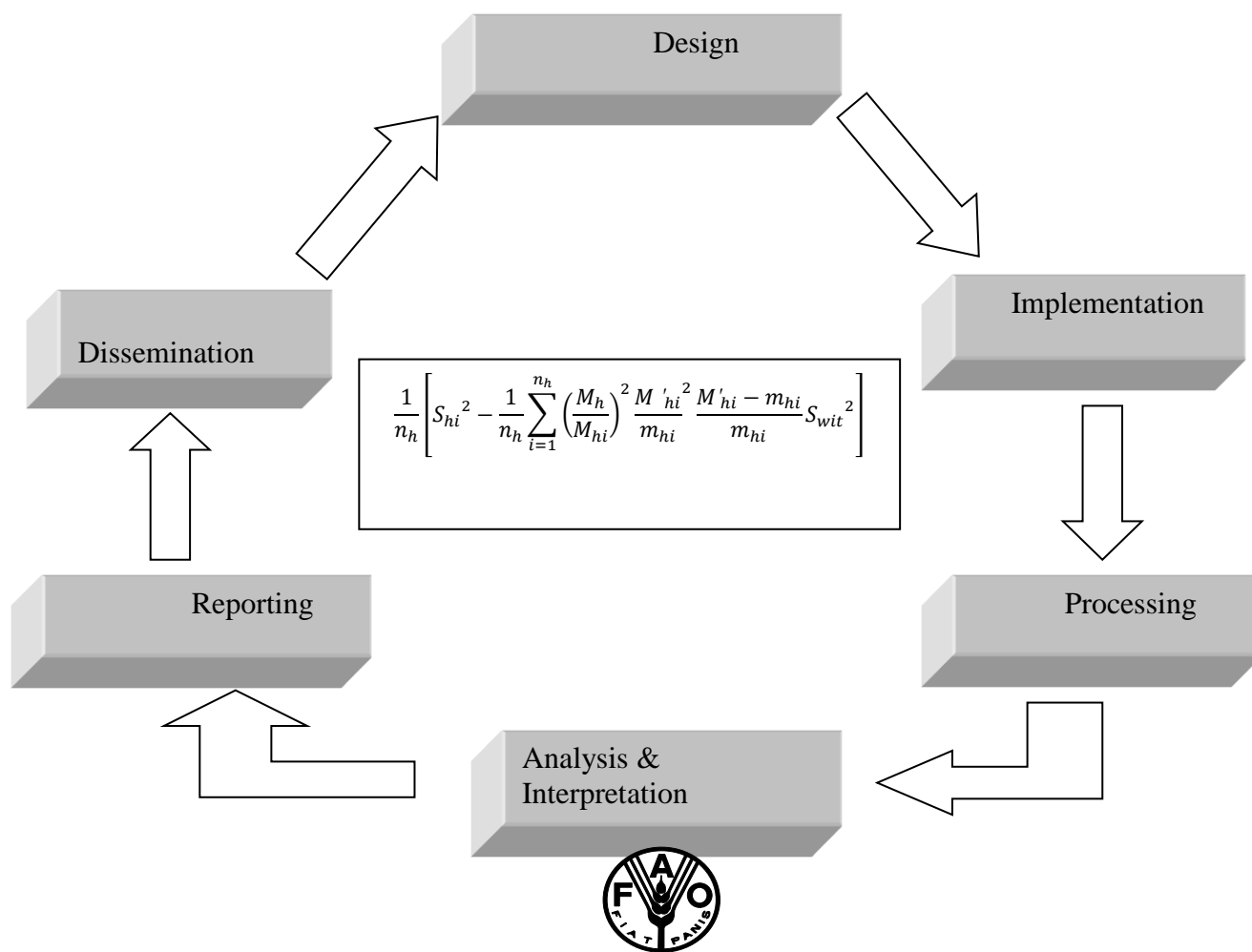


Kingdom of Lesotho



2009/2010 LESOTHO AGRICULTURAL CENSUS

VOLUME V: TECHNICAL REPORT



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BUREAU OF STATISTICS

MISSION STATEMENT

To provide accurate, relevant and timely information for decision making, policy and programme formulation, planning and research by both the public and private sectors for the well being of every Lesotho citizen.

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PREFACE

The government of the Kingdom of Lesotho through Bureau of Statistics (BOS), which was established in 1965, conducted the 2009/2010 Sampled Agricultural Census as part of Integrated National Household Survey Capability Programme. The country has been conducting decennial Agricultural Census since 1949 and Annual Agricultural Surveys since 1973. The objective of this census and all others taken before was to investigate characteristics of agricultural households, to assess food crop production and to provide benchmark data for agricultural industry. The added significance of the 2009/2010 census arises from that it coincides with the government's policy of alleviating poverty. This report constitutes volume V of the census reports.

It is hoped that this publication will serve as the guide for users. However, BOS is aware that some users may need more detailed information and for such cases, personal interviews are welcomed.

BOS through the Division of Agriculture and Food Security would like to thank the United Nations Organization (UN), in particular, the Food and Agriculture Organization (FAO) for supporting the Bureau through the data processing support. The project brought in consultants for professional support and data processing equipment. We acknowledge the support of FAO Representative in Lesotho Mr. Muwanga Zake who initiated the project is accorded a special appreciation and gratitude.

The success of this census was achieved through the cooperation and assistance that the Division of Agriculture and Food Security received from the Field Staff of Bureau of Statistics.

The staff of Agriculture and Food Security Division, under the leadership of Mr. Thabo Sophonea, the head of division.

L. LEFOSA

DIRECTOR

BUREAU OF STATISTICS

MINISTRY OF FINANCE AND DEVELOPMENT PLANNING

Definition of Terms

Agriculture: In this, agriculture is used to cover production of crops and livestock industry.

Agricultural Production: This includes growing and production of different type of crops. It also includes keeping of livestock products.

Agricultural Year: Unlike the population census where the reference is a point of time, the time reference for the agricultural year census is a full year and generally taken as agricultural year over which one full cycle of agricultural operation is carried out. Agricultural year in Lesotho commences on the 1st of August and ends on the 31st July of the following year.

Arable land: This is a land which is either under temporary fallow, temporary crops and under temporary meadows.

Cattle-Post: Establishment of small infrastructure known as motebo for production activities associated with the livestock.

Census: This is a total enumeration of people, holding or animals and related characteristics, within defined boundaries at a specified period of time.

Economically Active Population: To serve the purpose of this report economically active population concentrates on the population working in the agricultural holding and this comprises all persons of the either sex who provide the supply of labour for the production of agricultural goods and services.

Farming Households: A household, according to the preceding definition, where one or more persons are holders. In peasant farming there will normally be a one-to- one correspondence between the household and the holding. Holding can however also be operated by institutions, projects, etc.

Field: This is a piece of land cultivated as one by a holder, even if planted with different crops. An individual holding may consist of one or more such fields.

Fields Rented in/out: This includes total area of all holding rented or eased by the holder from other person, usually for a limited for a limited period of time. Rental may take different forms such as land rented for an agree amount of money or rented for a share etc.

Holder: A holder is a person who exercise management control over the agricultural holding operation and who takes major decisions regarding resource utilization and disbursement.

Holding: An Agricultural holding is an economic unit of agricultural production under a single management comprising all livestock kept and land used wholly or partly for agricultural production purposes, without regard to title, legal form or size. For the purpose of this report, the agricultural holdings are restricted to those that meet the following conditions:

- a) Households possessing both fields and livestock
- b) Households with fields but without livestock
- c) Households without fields but with livestock

Household:

- **A one-person household** is a person who occupies housing unit and makes provision for his or her own food or other essentials for living, without combining with other persons to form a multi person household.
- **A multi-person household** is a group of two or more persons who occupy the whole or part of one housing unit and make joint provisions for food and other essentials for living. Domestic servants living in the same housing unit are included in a multi person household.

Head of Household: This is a person who is acknowledged by all other members of the household either by virtue of his age or standing in the household as chief breadwinner. He/She is vested with responsibilities for maintenance of the household.

Livestock: Refers to all animals kept in the holding irrespective of ownership. Thus the number of animals kept in the kraal and cattle post on the reference date, owned or mafisad in, would be included in the count while mafisad out stock will be excluded. Similarly livestock on communal grazing land or in transit will be treated as located on the agricultural holding.

Mafisad: This means animals owned by one person but kept by somebody else.

Mixture: This is two or more crops planted simultaneously in the same field. The number, kind and proportion of crops in the mixture will generally vary according to the availability of seed, prevailing practices, soil, rainfall and other agro-meteorological conditions.

Pure Stand: This is a single crop cultivated in a field/plot.

Acronyms

AC	Agricultural Census
APS	Agricultural Production Survey
BOS	Bureau of Statistics
CI	Confidence Interval
CV	Coefficient of Variation
DEFF	Design Effect
DMA	Disaster Management Authority
EA	Enumeration Area
FA	Field Assistant
FAO	Food and Agricultural Organization of the United Nation
FO	Field Officer
GPS	Geographical Positioning System
IMPS	Integrated Microcomputer Program System
MDG	Millennium Development Goal
MSE	Mean Square Error
NMS	National Early Warning Unit
NSE	Non-Sampling Error
PPS	Probability Proportion to Size
PSU	Primary Sampling Unit
RSA	Republic of South Africa
SADC	Southern African Development Community
SE	Standard Error
SFO	Senior Filed Officer
SPSS	Statistical Package for Social Scientists
SRS	Simple Random Sample
SRV	Senqu River Valley
SSU	Secondary Sampling Unit
UN	United Nations
UNDP	United Nation Development Programme

Chapter 1

1.1 Introduction

This report has been prepared to give a technical description of the Agricultural Census (AC), which was carried out in Lesotho during the 2009/2010 Agricultural year. This AC is an exercise of an enlarged sample of the regular annual agricultural surveys, which have been going on in Lesotho since 1973/1974. However the AC covers other variables that are not covered by APS.

Data collection was carried out throughout the agricultural year 2009/2010. The Agricultural Year is divided into two periods (seasons). The first period starts from the 01st August to 31st January whereas the second period starts on 01st February to 31st July. Data on demographic characteristics and structural information was collected once during the survey year.

1.2 Background

Lesotho is the only Southern African Development Community (SADC) country completely surrounded by the Republic of South Africa (RSA). The population in the 2006 Population and Housing Census was 1,872,721. Out of the total area of about 3,035 thousand hectares, about 325 thousand hectares are suitable for farming. The western one-third of the country which is on the west characterized by flat, fertile, prairies-like land, where most of the agricultural activities are being practiced. The rest of the country is foothill or mountain rising steeply in the east to great altitudes, where crop production is difficult.

Lesotho comprises four distinct geographic zones: Lowland, Foothill, Mountain and Senqu (Orange) River Valley. These zones present marked climatological and ecological differences. The country is again divided into ten administrative districts namely Butha-Buthe, Leribe, Berea, Maseru, Mafeteng, Mohale's Hoek, Quthing, Qacha's Nek, Mokhotlong and Thaba-Tseka. Each district has one or more of the four agro-ecological zones, as summarized in Table 1.

Lowland: This constitutes by far the most densely populated and the most intensively cultivated of all the zones. It consists of a narrow belt, rising up to an altitude of about 1,500 to 1,800 meters above sea level. It is characterized by relatively high rainfall and allows cultivation of summer and winter cropping. The soil is susceptible to erosion especially by wind or flowing water.

Foothill: The zone is less populated than the lowland, and differs in having lower rainfall. It rises from 1,800 to 2,400 meters above sea level. The loose sandy topsoil is easily eroded by wind and rainwater due to over-grazing. It is characterized by relatively high rainfall and allows cultivation of summer and winter cropping.

Mountain: The zone is characterized by a very cold winter and is less populated than the above-mentioned zones. It rises to elevation of 3,500 meters and constitutes by far the largest, and yet the least densely populated portion of the country. Livestock is commonly found in this zone. This zone allows only summer cropping.

Senqu River Valley (SRV): This is a steep valley along the Orange/Senqu river, which runs from east to west across the country. The valley is characterized by low rainfall especially in the south-western portion and by its rich soil along the banks of the Senqu River. The zone also allows summer and winter cropping. Much of the valley floor is cultivated but valley sides provide grazing.

The principal crops grown in Lesotho are maize, beans, sorghum, wheat, peas and various types of vegetables. Apart from these, livestock farming is also important, especially in the mountain and foothill areas. Livestock species commonly found in Lesotho are cattle, sheep, goats, pigs, horses, donkeys, Cats, Dogs, Mules and poultry.

The prevailing shortage of labour, mainly due to migration to urban areas in the country and RSA, has had a very negative impact on agriculture, this is largely due to lack of employment opportunities and social facilities in rural areas, this lead to Low labour productivity in agriculture, poor producer prices and disproportion in number of able bodied males.

Table 1: Agro-Ecological Zones Present in the Districts of Lesotho

District	Lowland	Foothill	Mountain	Senqu River Vally
Botha-Bothe	*	*	*	
Leribe	*	*	*	
Berea	*	*		
Maseru	*	*	*	
Mafeteng	*	*		
Mohale's Hoek	*	*	*	*
Quthing			*	*
Qacha's Nek			*	*
Mokhotlong			*	
Thaba-Tseka			*	*

1.3 History of Agricultural Censuses and Surveys in Lesotho

Lesotho has a history of almost half a century in agricultural census undertaking. The first documented agricultural count was conducted in 1949/1950 under the Food and Agricultural Organization (FAO) of the United Nations (UN) by the Ministry of Agriculture and Food Security which was called department of agriculture during that census period. The 1960 Census was the second to be conducted in Lesotho, also by the Ministry of Agriculture and Food Security and the FAO supported the census financially and technically.

Since the establishment of the Bureau of Statistics (BOS) in 1965, Lesotho has been undertaking agricultural census every tenth year starting with 1969/1970 agricultural census. The most recent agricultural census was taken in 1999/2000 which covered urban areas, whereas, the other censuses only dealt with rural areas. The 2009/2010 was the second to cover both rural and urban areas.

Community level data was a new module of the 2009/2010 Agricultural Census as recommended by FAO for 2010 round of agricultural censuses. Past Agricultural Census programmes have focused on data on the structure of agricultural holdings collected directly from each agricultural holding. These structural data concern matters that are decided upon by the holding, such as what crops to grow and what agricultural inputs to use and therefore can only be reported by the holding itself, not by public administrations. However, some type of administrative data are of interest in an agricultural census, especially for decentralized planning, identification of poor villages, planning of targeted area development programs, constructing sampling frames and targeting communities for relief operations in case of natural disasters.

Community-level data collection, often at the village or commune level was useful for examining the infrastructure and services available to holdings. Data on whether the community is prone to natural disaster or subject to seasonal food shortages was of interest for food security analysis. Community-level data covered agricultural related data that is normally not collected from holdings, such as the area of communal land.

In censuses most events are reported retrospectively, therefore they are subject to memory lapse and mis-reporting errors. These errors could be minimized by probing and having a close supervision to the enumerators. This is particularly crucial in societies at lower levels of modernization such as lack of numeracy and literacy. All these have introduced another source of error in the data.

Lessons learnt and challenges from past agricultural census were that, there is a growing demand for gender disaggregated agriculture data, it is critical to provide accurate, relevant and timely information and there is a need to publish information by lower administration levels, information distributed by districts only is not adequate. (VOLUME IIIA: POPULATION DYNAMICS 1996)

The 2009/2010 agricultural census increased sample size for more accurate and reliable information even at the lowest administration of accuracy and cost effectiveness of field area measurement, a core census module (community-level data) was also conducted on a complete enumeration basis. A limited range of key structural items of importance for national policy-making, international comparisons, constructing sampling frames and analysis of data at detailed lower geographic and community council level were provided. Core module was conducted before the actual census, decentralization and local government structures such as community councils needed information for planning and provision of services. Timely release of census resulted in order to update the 2008 millennium development goals (MDGs) status report for the 2010 UN general assembly and mobilization of resources.

1.4 The Need for the Census

The Lesotho Government, through the BOS embarked on agricultural census during the 2009/2010 agricultural year. Planned economic development called for more diversified and intensive efforts in agriculture and the planning of these efforts demanded periodic conducting of agricultural censuses and surveys.

For effective Government economic policy decisions formulation of sound and realistic development programs, Government needs an annual basis detailed and reliable statistics concerning the agricultural resources in the country, the present status of

their utilization and potentialities for further development. Such data are provided annually through the Agricultural Production Survey.

The decennial census is needed for providing information on variables that do not change much over time. For those variables that are subject to frequent and seasonal changes it is desirable that information be collected at more frequent intervals. It was thus one of the objectives to provide the necessary structural and agro-economic surveys.

A census of agriculture aims at collecting country-wide data concerning the chief characteristics of the agriculture in such a manner that the data can be interrelated by operational agricultural holding, which form the units for enumeration so as to provide an integrated picture of the country's agricultural structure. An agricultural census is undertaken as a source of basic statistics on a wide range of subjects. The information collected would be important for sound planning of projects designed to increase agricultural production in general.

As a result of recent changes in cultivation systems from introduction of sharecropping by farmers with the Government as well as private contractors, new types of data on the structure and organization of agriculture under such systems are called for. Special emphasis in this census, as distinct from the past ones, was to re-orientate the data collection program to the needs of development planning and administration, which was felt both extensively in the past.

The census provides information on characteristics of holding, the structure of agriculture and the social, economics, and institutional factors influencing and limiting production, which helps in assessing the type of development required and the optimum allocation and utilization of resources among various projects needed for this purpose. The connection between agricultural census and agricultural planning is so vital that the census deserves to be incorporated in a country's agricultural plan itself and assigned a high priority. Such being the status of agriculture and its importance in the national economy, the successive development plans of the country have emphasized imperative need to maximize returns from its limited land resources and to give increased attention to its hitherto neglected rural areas.

The agricultural development programmers aim at general improvement in crop yield to achieve self-sufficiency, increased crop-derived income and promotion of commercial livestock production, the establishment of an efficient input supply system and producer oriented market organization. In addition to providing the usual basic data on structural and other related characteristics of agriculture as covered in the past surveys and censuses, this census was designed to meet the statistical requirement of more diversified and intensified development planning and administration of the national economy.

Agricultural census is needed in Structural Adjustment Policy in order to provide better understanding, monitoring and evaluating appropriate policy intervention to mitigate social, economical and political costs. The structural adjustment policy has created the need for additional agricultural statistics, to show the imbalances between production and consumption, consumption and saving, imports and exports, public expenditure, public revenue, etc.

In many cases, the required information has been obtained after an agreement with the related planning agencies, either directly or through seminars. The demand for special information in this field had called for the reappraisal and modification of agricultural statistics activities but it has often stretched the resources of the statistical agencies responsible. In order to understand the impact of structural adjustment on agricultural statistics, certain analyses should be undertaken. The most appropriate starting point as a primary unit of observation is the *household*, which is to be considered both as a producing and a consuming unit. The principal purpose of taking the household as a consuming unit is also to better understand the conditions of access to food, i.e. whether it is physically and economically available and the extent of food insecurity, whether transitory or chronic.

The imbalances attributable to excessive domestic demand are being corrected through fiscal and monetary means, which aim at bringing the level and growth rate of agricultural demand in line with level and growth rate of agricultural production capacity in Lesotho. It should be noted that although some of the data are aggregated to produce blankets with clearly indicate the need for thorough and more detailed investigations in order to reveal cases or situations.

The FAO recommends that censuses be carried out at regular intervals. The collection of information every ten years shows the changes that have occurred in the structure of agriculture in the intervening period. Hence this was the time for Lesotho to conduct its sixth agricultural census.

1.4.1 The goals of 2009/2010 Agricultural Census

The Agricultural census results provide a benchmark against which future agricultural development (planning) is measured. Planning involves setting up of national targets of production, the resources and other measures required for achieving them, a program and a time-table for working towards these targets.

The main objective of the Agricultural census was to provide information used to monitor achievements in the implementation of the key priorities of Lesotho as articulated in the Poverty Reduction Strategy (PRS) over the past ten years and in particular interest for monitoring of the priority area of improving agricultural production and food security. Data collected from Agricultural Census provide information on progress in the implementation of strategic designed to attain this indicator.

Moreover, information will achieve the following

- Inform policy makers and planners in the government, private sectors, as well as cooperating partners on the level of progress that Lesotho has attained in meeting the Millennium Development Goal (MDG's) of eradicating extreme poverty and hunger; specifically the two targets of reducing by half the proportion of people who live below poverty-line and halving the proportion of the people who suffer from hunger.
- Provide accurate and relevant agricultural information to the government and private sector for the improvement of the agriculture sub-sectors.
- To provide information on economic situation in agriculture and to monitor the impact of all agriculture related projects which were intended to improve the lives of agricultural households.

- Determine the number, distribution in space and main characteristics of farming households.
- To assess the impact of several interventions in the form of projects, programmes and policies in the agricultural sector
- Ensuring Environmental Sustainability

Chapter 2

2.1 Census Planning

As many countries, legislation governing statistical data collection should always be considered first. Such legislation makes it obligatory for each individual in a country to provide the information asked for and has to have some legal sanction behind it. Accordingly, agricultural censuses are carried out on the basis of suitable enactments, which may be temporary for the purpose of a particular census or a permanent piece of legislation, which requires that an agricultural census be carried out at specific intervals. An important aspect also is the confidentiality of individual information being collected.

The implementation of the 1999/2000 census is based on the 1965 Statistics Act. The Act empowers the Director of Statistics or Statistics or an authorized officer to collect, compile and analyse all the census information.

The power of conducting Agricultural census was vested on the Minister of Finance and Development Planning. The Director of Bureau of Statistics (BOS) was the commissioner, who provided policy guidelines and mobilizes all necessary resources.

The establishment of census committee to act as a steering group was essential for the successful implementation of census. The committee was known as Agricultural Advisory committee and was established April 2008 when preparation of Agricultural Census commenced.

The Advisory Committee was composed of Bureau of Statistics Staff members, representatives from different government ministries, non-government organization and private sector.

The main responsibility was to advice on the technical aspects of the survey such as the design and production of survey instruments.

2.2 Census Team and their Main responsibilities

2.2.1 Survey Committee

The director was responsible for the proper execution of the census plan with the assistance of the following teams: Senior Management Team (SMT), Survey Committee, Logistics Team, Agricultural Census Advisory Committee, Standards and Methodologies Team, Publicity Team, Data Collection Administration Team, Data Processing Team and Analysis Team.

2.2.2 Senior Management Team

The team was comprise of Heads of BOS divisions and was headed by the Director as census commissioner. The Deputy Commissioner was the Head of Agriculture and Food Security whose main task was to oversee smooth running of the census and attend day-to-day problems.

2.2.3 Financial Controller

Financial Controller was in charge of the census budget and ensured that all financial transactions were in line with financial regulations. The Controller was also responsible for the production of a financial report.

2.2.4 Logistics Team

The team was comprised of the BOS Administration Officers, Human Resource Officers, Transport Officers and Procurement Officers.

- **Human Resource Officers;** they were responsible for recruitment and deployment of staff in accordance with Public Service rules and regulations. They also attended human resource related issues arising from the field.
- **Procurement Officers;** they were responsible for procurement of equipment, goods and services required for the census in accordance with Government procurement procedures.
- **Administration Officers;** they were responsible for all logistics-related issues pertaining to the census such as accommodation, training facilities and ensured that census materials were printed.
- **Transport Officers;** they were responsible for securing transport for entire running of the project for all the districts.

2.2.5 Standards and Methodologies Team

The team was responsible on sampling issues. They also monitor data quality checks so as to measure sampling and non-sampling errors. The team further ensures that the equipment such as measuring tape, sample plot cutting tools and GPS were on standard. They were also for production of technical report of the census.

2.2.6 Publicity Committee

The publicity committee was composed of the technical staff of BOS. The committee was responsible for publicizing the Agricultural Census activities. It plays the leading role of bringing together different ministries, so as to ease communication between enumerators and the public, as well as to sensitize the public about the activities of the survey.

2.3 Data Collection Administration Team

2.3.1 District Coordinators

Their responsibility is to coordinate in the districts and to do post checking of all data collected including solving problems that may arise.

2.3.2 Districts Supervisors

Their responsibility is for districts or an area. Their responsibility is to supervise Assistant Supervisors, to see to it that questionnaires are properly filled and arrive in time at headquarters.

2.3.3 Assistant Supervisors

These are districts or area supervisors who are responsible for proper and timely data collection. They are also responsible for accuracy of data collected and distributing work among the Enumerators.

2.3.4 Enumerators

Their responsibility is to collect all data in their respective Primary Sampling Units.

2.3.5 Recording Clerks

They are to record all questionnaires from the field. The records are to be kept by Districts, Primary Sampling Unit number, Household number, Field number, crop and Location of field, including livestock numbers.

2.4 Data Processing Team

2.4.1 Programmers

They are designing entry screen, data verification, electronic editing of the data, data cleaning and running of tables.

2.4.2 Data Entry Supervisors

Their responsibility is the overall supervision of the data entry and verification.

2.4.3 Data Coding and Editing Clerks

They are to edit and code questionnaires from the fields, recording the edited and coded data on the computers.

2.4.4 Data Entry Clerks

They are responsible for electronic data entry.

2.5 Census Analysis Team

They are responsible for the formulation of analysis strategy and development of the tabulation plan. There is also tasked with the responsibility of analyzing data, dissemination and production of census report.

2.6 Authority for the Census

As in many countries, legislation governing statistical data collection should always be in place. Such legislation makes it obligatory for prospective respondent in a country to provide information asked for with corresponding appropriate sanction in case of a default. Accordingly, agricultural censuses are carried out on the basis of suitable enactments, which may be temporary for the purpose of a particular census or permanent piece of legislation, which requires that an agricultural census be carried out at specific intervals. An important aspect of the legislation is also the confidentiality of individual information being collected.

In this regard the implementation of the 2009/2010 census was based on the statistical act 2001. The act empowers the Director of Statistics or anyone with delegated authority to collect, compile and analyze all the census information.

2.7 Planning of the Census

2.7.1 Preparations for the Census (Work Plan, Budget and Expenditure)

This chapter deals with the basic activities which followed the decision to conduct an agricultural census. These were:

- 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.

2.7.2 Work Plan by Activity

The work plan in annex 1 is presented as a chart identifying all the key activities of the census in a time frame (preparation, field work, etc.) and showing the relationship between them. Time is shown in months. 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.

It is often more practical as it has broken down the general work plan into several broad subject matter areas or phases; thus, prepare a field enumeration work plan, a training work plan, a data processing work plan, etc. In this case, the census coordinator had ensured the necessary consistency of these work plans.

2.7.3 Preparation of the Budget

For Agricultural census, as for any statistical operation, the budget prepared in accordance with the rules and regulations of the government. It conformed to the standard set forth by the authorities empowered to approve and appropriate the necessary funds. It was 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 was generally less detailed than the financial outline and was presented, for instance, all salaries and wages regrouped by year, the staff requirements of the census vary largely beginning with a fairly small technical group of persons for preparatory work, subsequently enumerators and supervisors for the enumeration. The entire amount was shown on the budget for the appropriate financial year, followed by the recruitment of personnel required for data processing and finally for activities of dissemination. Each financial plan has 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 working on the census has been accurately provided. Furthermore, the primary enumerators and field supervisors were working permanently for the census.

2.8 Cartography Preparation

It presents an overview of cartographic preparations for agric census in order to guarantee adequate coverage, precision and presentation of the collected data. Maps used for statistical purposes include topographic charts, aerial photography, and satellite imagery and even sketches prepared to facilitate data collection when no other materials are available.

Maps were essential for conducting agricultural censuses and surveys. Maps used in planning, preparing the frames, organizing and conducting the field data collection and presenting and analyzing results.

The most parameter on a map was the scale, which was the ratio representation of the magnitude of the land. The scale was presented on a map and appears as fraction.

A large proportion of the cartographic preparations for agric census consist of delineating and identifying enumerators' area of work, that was, the enumeration areas (EA) which were components of the agric census frame. The construction of the census frame was undertaken as part of the census field data collection preparatory activities.

The largest proportion of the cartographic support for an agricultural census was the preparation of the sampling frames corresponding to each sample selection stage including detailed mapping to support data collection.

2.8.1 Maps Identification

Maps for identifying enumeration areas (EAs) were used in the field by agricultural census enumerators for data collection. These were scale field maps, 1/7,000, or larger but not exceeding 1/10,000, which helped the enumerator locate the enumeration area 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. Enumeration area map symbols follow cartographic standards and preferably self-explanatory, not requiring special complex training instructions for the enumerators.

Maps 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 presented simply and effectively.

2.8.2 Satellite Images.

Many different types of maps can be used for the Censuses or Survey, but agricultural census used satellite images.

Satellite images (available on paper) were very valuable and provided useful information as they gave a detailed picture of the land and provided information on land used, agricultural patterns and practices, population density and infrastructures. Satellite images were used in a number of countries, for example as an instrument for improving the methods of agricultural statistics data collection.

Calendar of Pre-census Activities

	ACTIVITY	Starting Date	Finishing Date
1	1 st Advisory's meeting	15/04/2008	15/04/2008
2	Design of draft questionnaires	17/04/2008	17/05/2008
3	2 nd Advisory meeting-questionnaires	20/05/2008	21/05/2008
4	Preparation of Proclamation and Order	16/07/2008	18/07/2008
5	User/Producer meeting	20/11/2008	20/11/2008
6	Final Questionnaires	15/04/2009	16/04/2009
7	Final Manual of Instructions	19/04/2009	23/05/2009
7	Selection of Primary Sampling Units	01/04/2009	14/04/2009
8	Printing of questionnaires	03/04/2009	30/04/2009
9	Recruitment and training of Temporary FA	01/04/2009	30/05/2009
10	Recruitment and training of Temporary Clerks	01/06/2009	30/06/2000
11	Pre-listing of PSUs	15/04/2009	18/05/2009
12	Selection of households	20/05/2009	03/06/2009

2.9 The Financial Outline

From the work plan a financial outline was drawn up by assigning costs to specific activities. Here, two kinds of costs were distinguished: Those for which the total cost derives directly from the product of a unit cost and a physical quantity. For instance, the total number of computers required for data entry and the purchasing cost. 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 were the printing costs (questionnaires, reports, manuals, etc.) including the fixed costs and the variable costs where unit costs may decrease with quantity.

2.9.1 Pre-Enumeration Phase. The financial outline 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, 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) 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.

2.9.2 Field Operation Phase. The costs for this phase 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; quality control; and delivery of completed questionnaires to the respective offices or central office.

2.9.3 Post-Enumeration Phase. The cost estimates for this phase 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.

2.9.4 The other costs were:

- **Travel expenses:** These include mainly cost estimates of transportation and Allowances of employees.
- **Equipment requirements and data processing** have been estimated in relation to the workload involved and anticipated expenditure involved in the purchase and hire of vehicles, horses etc.
- **Printing costs:** An agricultural census had a huge printing programme. The large number of questionnaires was printed and considerable of other materials, such as the instructions manuals.
- **Office expenses and miscellaneous costs** include hiring of office space and furniture, purchase of stationery, required equipment, freezer's suits and boots for enumerators, administrative and miscellaneous services, supplies and materials of office staff involved in the operation, accounting control forms and communication expenses, etc.

2.10 Census Coverage

The census covered all agricultural areas of the country and extended over the entire agricultural year from August 2009 to July 2010. Urban centres and peripheral areas with at least some horticulture, dairy and poultry in house compounds, were also included. Excluded were pure cattle posts and institutional posts, which had no fields, cultivated and which had their livestock enumerated at the agricultural holding, which possessed them.

The main census covered on a sample basis traditional holding, i.e. all land that was allotted by the chiefs to individual Basotho families for the purposes of crop cultivation. The census provided an elaboration of certain items to meet current demands for additional data. For instance, more information was collected about various forms of tenure of agricultural land in response to the needs for instituting reform in agrarian tenure. Under land utilization, temporarily fallow land and kitchen gardens were included. Data on fruit bearing trees was also recorded. All households with at least one field or one cattle or/and five sheep/goats were covered.

In addition to the traditional holdings, certain institutional holdings were also included in the census. Examples of such holdings are Government institutions, religious missions and other institutions, which engage in some forms of agricultural activity, and commercial farming. In order to establish the magnitude and nature of these activities, a complete enumeration of communal gardens, mission gardens, prison gardens and all institutional farms like research and demonstration farms, farmers training centres farms, irrigation schemes, agricultural mission farms and commercial poultry farms in the selected PSU's was also undertaken.

Chapter 3

3.1 Census Questionnaire

The questionnaires used for census were in appendix 1. Most of the census questionnaires were derived from forms used during Agricultural Production Survey (APS), but some questionnaires were designed specifically for census. The questionnaire used for data collection from peasant farmers in rural areas included eleven forms, AC-1 to AC-11. These forms were designed for data collection from institutional holdings. The forms designed for data collection in urban areas included six forms UAC-1 to UAC-6, two of the forms were designed for data collection on kitchen gardens and livestock.

Form AC-1; Used at the beginning of the census to compile a complete and updated list of all agricultural holders in each selected PSU. The main purpose for listing households was to enable second stage of sampling, i.e. selection of households, which were the census units of enumeration. Listing of 2009/2010 included the core module (community-level data) which covered the whole country.

The listing operation was thoroughly checked by the district supervisors together with other headquarters officers at district level, and then district coordinator(s) extensively moved around the areas monitoring data collection and also checked and scrutinized completed questionnaires if error had occurred.

Form AC-2(i&ii); Information was on major of demographic characteristics of the sampled holders, household members, age, sex residential status, education and main occupation, ownership of the field and the total number of fields for household.

Form AC-3; After having listed fields of the holding, this form was used for recording actual field measurements, the crops planted on each field and field also sketched. Supervisors using programmable calculators to make calculations of areas for each field, in other districts field was determined by Global Positioning System (GPS) to measure the actual dimension of each field and fallow portion in the field. The information was also collected on the number of fruit trees.

Area measurement of the fields was described in the manual of instruction in appendix 2 Enumerators were provided with the measuring tools like measuring tape, compass, wire pegs and GPS.

Form AC-4; Used to prepare a frame of fields planted to each of the five crops; maize, sorghum, wheat, beans and peas and or mixtures.

Form AC-5(i ii&iii); The form was used for collecting data on how each field was operated, which inputs were used. Data on the methods used for ploughing, weeding/cultivation, planting and harvesting & storage were also collected, as well as data on the type and amount of pesticides, fertilizers and seeds were also collected.

Form AC-6; Information on complete crop failure or pre-harvest loss if any and causes of failure in the fields included in the sample were recorded using this form.

Form AC-7; Sketched field was drawn in this form and the yield of the sample cuts were recorded in this form and the weight of the crop harvested.

During community-level data collection, enumerators were first report themselves to the chief or headman as soon as they entered the village. They introduce themselves to the chief, what authority they represented, the purpose of their visit, and their future visits during the agricultural census year. Community-level data was collected at each village level and the chief/headman or community leader provides the required information on behalf of the community.

On completion of listing households and community-level data in each PSU, filled questionnaires were collected by supervisors to Bureau's districts offices for editing. Questionnaires were finally transferred to Bureau's headquarters for identification, stratification of agricultural and non-agricultural households, then selection of sampled households in each selected PSUs were distributed to all districts in all selected PSUs to carry out the detailed census enquiries by enumerators.

Basic characteristics of the holdings

The number of fields of each selected agricultural household was subdivided by;

- i. Fields owned and owner operated
- ii. Fields owned and share-cropped with others
- iii. Fields owned but operated by project
- iv. Fields not owned but operated due to rented in, borrowed or exchange from others
- v. Fields owned but rented out

The last category, i.e. (V) above was left out since the production from the rented out fields was not coming to the selected household. The classification of the operation was determined separately for the winter and summer seasons at the beginning of the each season. Information on general holding characteristics like type of holding, method of operating land, source of supply of inputs, selected practices and facilities obtained with reference to the holding as a whole and generally with reference to the main crop season was collected.

Similarly, information on land utilization giving details of crops and fallow land, land tenure and farming system (including renting and share-cropping), irrigation and use of other inputs, share-cropping and produce sharing practices and extension or abandonment of cultivation were collected field by field for each season. Each crop was identified by a code number which remains consistent in all relevant questionnaires relating to field.

The final formats for the questionnaire were derived through several meetings with stakeholders; they included Food and Agricultural Organization of the United Nations (FAO), World Food Programme (WFP), United Nations Development Programme (UNDP), Disaster Management Authority (DMA), Lesotho Vulnerability Committee, Ministry of Finance and Development Planning, Ministry of Agriculture and Food security in the department of research, livestock, crops and planning, Ministry of Trade and Industry in the department of cooperatives and marketing etc.

3.2 Comparison between 2009/2010 AND 1999/2000 agricultural census questionnaire

Cover page

For 2009/2010 questionnaire, title “The information is confidential” was according to the statistics act 2001 while 1999/2000 questionnaire was according to the act 1965. 1999/2000 Agricultural census questionnaire was defined by large boundaries which were just the districts and zones, while the 2009/2010 Agric Census questionnaire includes smaller boundaries which were the constituencies and community councils.

FormAC-1 2009/2010 and Form AC-1 1999/2000

2009/2010 form was headed rural household listing while 1999/2000 form was headed household listing. In column 6, poultry and pigs were now included in 2009/2010 questionnaire because nowadays most of the household own an improved poultry and pigs.

FormAC-2(i) 2009/2010 and Form AC-2 1999/2000

The question in column 3 regarding the relationship to household head has broken down “other relatives” into siblings and grandparent, just to be more accurate than before. Also “not related” was included because more households have other people living together who were not their relatives. In column 6 main activities for the past twelve months have broken down the code unemployment which was used on the last agric census to job seeking and job seeking for the first time so as to be more specific than before. Moreover it added housewife, retired, disabled and farmer.

Educational level attained in column 8: there was an improvement at educational level than before, therefore there were certificates categories added since nowadays most people had attained different levels of education. In column 10, the 2009/2010 agric census classifies household heads who were “absent but outside Lesotho” into household heads who were “outside Lesotho but in RSA” and those who were “outside Lesotho and RSA”. The reason could be that most household heads in the country were in RSA (e.g. mineworkers) and other countries that were beyond RSA though were Basotho.

The annual income level question in column 11 was added in 2009/2010 because most household members who were above six years of age were subjected to earnings even if they were unemployed. On the source of income question, the codes; pension fund, block farming and wage/salary were now included since of late there were earnings through those codes.

FormAC-2(ii) 2009/2010 and FormAC-3 1999/2000

On the question about the type of operation in column 3, the codes “not owned but rented in, owned but operated by block farming and not owned but operated by block farming” were added. The main reason could be due to the fact that there was no block farming before. In column 7, for the loss of land question, the code “soil erosion” was broken into “sheet erosion, rill erosion and riverbank erosion”, the reason being that at the last census (1999/2000), it was found that soil erosion did occur but it was not specified, so they specify it to be more realistic. In column 8, the question about unproductive land was added because most of the fields were losing productivity. The interest was to find the main reasons for the loss, whether the farmers participate in soil control measures and whether there were terraces in the fields, that was why the

form added the questions about the soil control measure in column 10 and the terraces in column 11.

FormAC-3 2009/2010 and FormAC-4 1999/2000

The question about the crop mixtures estimates and the proportion occupied by each crop was included as to find if households were involved in mixed cropping because mixed crop prevent soil erosion and maintain soil fertility. Since households were planting fruit trees of late, the question about the fruit trees planted on the field and whether they were sold were also included because fruits could be commercialized.

FormAC-4 2009/2010 and FormAC-5 1999/2000

The 2009/2010 was headed field listing by crop while the 1999/2000 was headed field listing otherwise there were no differences in the two forms.

FormAC-5(i) 2009/2010 and FormAC-6 1999/2000

Most of the farmers owned or operate more than one field and it was observed that other farmers had fields but unable to operate because of poverty, insufficient capital and or not interested in farming, so other farmers either rent it or borrow, therefore they added field number on the questionnaire and the question about type of operation in column 3. There were some expenses on all different activities like ploughing disking and weeding, therefore the question about amount used on all those activities was included.

Form 5(ii) 2009/2010 and FormAC-6 1999/2000

The 2009/2010 form and 1999/2000 form were not different except that they included the codes “combination and not used” because some farmers use more than one fertilizers and pesticides.

FormAC-5(iii) 2009/2010

There was no corresponding form; it was a new form about operations and cost. It was introduced because most of the farmers had expenses in every operation.

FormAC-6 2009/2010 and FormAC-9 1999/2000

Form AC-6 2009/2010 corresponds to form AC-9 1999/2000 and the details inside both forms were the same. The only difference was that form AC-9 in 1999/2000 was broken down to formAC-5(i), formAC-5(ii) and formAC-5(iii) in 2009/2010.

Form AC-7 2009/2010 and FormAC-7 1999/2000

There was no difference on the two forms.

FormAC-8 2009/2009 and FormAC-8 1999/2000

In these two forms everything was the same, nothing different.

Form AC-9 2009/2010

There was no corresponding form; it was a new form about Availability and Utilization of cereals in the household: To check the production available to a particular farmer and to look whether they produce or purchase cereals and how they spent those cereals.

FormAC-10 2009/2010 and FormAC-10 1999/2000

Farmers owned an improved livestock which were rams and hammel than before. Those rams and hammel were used for wool and mohair, also to produce improved calves.

Furthermore, most of the household nowadays owned many kinds of poultry including koekoex and unimproved chicken; therefore they were added to the questionnaire.

FormAC-11 2009/2010

Under machinery and equipment at the holding: The current census includes the question about the number of items rented. Since of late, it was common to rent other people's machinery and equipment. Under auxiliary items/activities, most of the household were involved in poultry nowadays. Since most of the people now have access to irrigating facilities, that was dams, rivers etc. The question about access to irrigating water was added in the current census.

Form UAC

Form UAC was the same as Form AC questionnaire, except that Form UAC-1 in column 4 had a question which asked about the kitchen garden and in Form UAC-3 an auxiliary items had a code "number of scortcharts".

3.3 Testing of questionnaires

As the country had a long experience of agricultural census taking, an elaborated field test was not conducted. However, one might consider the 2008/2009 APS as a full-scale test, since most of the forms for the census were used in this survey.

The Agricultural Statisticians, Statistical Officers and Senior Field Officers of the Bureau of Statistics and the Field Officers, i.e. the district level supervisors participated in agricultural production surveys and censuses. This exercise also helped to finalize the field procedures.

3.4 Concepts and definitions

The definitions and concepts of most census items are as set down in the 1980 and 1990 World Census of Agricultural Regional Programme for Africa. Most of the definitions relate exclusively to agricultural statistics, although some are common to other fields of statistics with the aim of ensuring that the concepts and definitions used in the agricultural census and in agricultural statistics are in harmony with those used in other related fields of statistics. Where necessary these were also given in the different sets of instructions appended. The following however, may be mentioned here:

Primary Sampling Unit (PSU): This represents a constant statistical area identifiable by geographical boundaries defined by physical features and important landmarks and delimited in terms of a certain size of population living in villages within the area.

Household:

- (a) **A one-person household** is a person who occupies housing unit and makes provision for his or her own food or other essentials for living, without combining with other persons to form a multi-person household.
- (b) **A multi-person household** is a group of two or more persons who occupy the whole or part of one housing unit and make joint provisions for food or other essentials for living. Domestic servants living in the same housing unit are included in a multi-person household.

Head of Household: This is a person who is acknowledged by all other members of the household either by virtue of his age or standing in the household as chief breadwinner. He is vested with responsibilities for maintenance of the household.

Holding: An agricultural holding is an economic unit of agricultural production under single management. It consists of all livestock kept and all land used for agricultural production without regard to title. For the purpose of this Census, the agricultural holdings are restricted to those which meet one or more of the following conditions:

- (a) having or operating at least one field of land
- (b) raising one or more cattle
- (c) raising five or more goats and/or sheep

Thus, holding without land and without cattle and with less than five goats or sheep are not included in the census.

Holder: A holder is a person who exercises management control over the agricultural holding operation and who takes major decisions regarding resource utilization or disbursement.

Farming Household: A household, according to the preceding definition, where one or more persons are holders. In peasant farming there will normally be a one-to-one correspondence between the household and the holding. Holding can however also be operated by institutions, projects, etc.

Field: This is a contiguous piece of land cultivated as one by a holder, even if planted with different crops. An individual holding may consist of one or more such fields.

Plot: This is a portion of a field planted with one specific crop, e.g. Maize or Sorghum, or a crop mixture, e.g. Maize-Beans mixture.

Subplot: This is a small area on the field where crop cutting is performed.

Livestock: Refers to all animals kept in the holding irrespective of ownership. Thus the number of animals kept in the kraal and cattle post on the reference date, owned or mafisad¹ in, would be included in the count while mafisad¹ out stock will be excluded. Similarly livestock on communal grazing land or in transit will be treated as located on the agricultural holding.

Arable Land: This is a land which is either under temporary fallow, temporary crops and under temporary meadows.

Harvested Area: This refers to total area where crop has been gathered.

¹ Mafisad means animals owned by one person, but kept by somebody else.

Fields Rented in/out: This includes total area of all holding rented or eased by the Holder from other person, usually for a limited period of time. Rental may take different forms such as land rented for an agreed amount of money or rented for a produce share etc.

Mixture: This is two or more crops planted simultaneously in the same field. The number, kind and proportion of crops in the mixture will generally vary according to the availability of seed, prevailing practices, soil, rainfall and other agro-meteorological conditions.

Pure Stand: This is a single crop cultivated in a field/plot.

Agricultural Year: Unlike the population census where the time reference is a point of time, the time reference for the agricultural census is a full cycle of agricultural operation is carried out. Agricultural year in Lesotho commences on the 1st of August and ends on the 31st of July of the following year. Since the census is being conducted during the agricultural year 1999/2000, the months August to December relate to the year 1999, and the months January to August relate to the year 2000.

3.5 Field work

The census was conducted in three phases.

In the first phase all households were listed throughout the country and collection of community profile was done. Institutional holding, like schools, projects etc. were also listed. From these lists the sample of holdings was selected.

In the second phase:

- (a) the household members were listed.
- (b) all fields operated by the sampled holding and planted with winter crops or
felt fallow for the season were measured.
- (c) the livestock numbers by age and sex were ascertained.
- (d) crop cutting of subplots for winter wheat and peas was made; and
- (e) information was collected on the use of fertilizers and protective chemicals applied to winter crops; crop failures; interviews on farmer's estimated yield even on crops not subjected to crop cutting, and information on machinery and building and workers on the holding.

In the third phase:

- (a) all fields of the sampled holding planted with summer crops or fallow in summer were measured or their measurement if taken already in the winter season were checked;
- (b) crop cutting of subplots for maize, sorghum, beans, summer wheat and during this year were made; and
- (c) information on use of fertilizers and protective chemicals applied to Summer crops as well as crop failure and interview data on not subject to crop cutting were collected.

Table 3 below summarizes the data collection activities in the form of a Calendar of field activities.

Table 3: Calendar of Field Activities

MONTH													
	2009						2010						
Form	7	8	9	10	11	12	1	2	3	4	5	6	7
AC-1													
AC-2(i)		X											
AC-2 (ii)		X						X					
AC-3		X											
AC-4		X											
AC-5(i)		X											
AC-5(ii)		X											
AC-5(iii)						X						X	
AC-6							X					X	
AC-7					X				X				
AC-8					X								
AC-9									X				
AC-10		X						X					
AC-11										X			
AC-12													

3.6 Census staff

The census staff was divided into field force and head quarters staff. No other staff from other ministries was involved in the census operation.

The field force consisted of 134 enumerators (field assistants) of whom about 67 were temporarily employed, 27 field supervisors (field officers) and 5 District Supervisors. The headquarters staff was composed of statistical clerks who were 20 and Professional staff.

3.7 Training

Training was first held for the Senior Field Officers. The purpose of these training sessions was to review the questionnaires and the logistics of the census as most of the questionnaires used for the census were the same as the Agricultural Production Survey but the census questionnaire was more simplified and had other things that were included which were not there at the APS questionnaires.

The second training session was for the census supervisors. Most of them had experience from the past censuses and surveys and they were acquainted with most of the questionnaires and field procedures.

The last training before commencement of field operation was for all the enumerators. The temporary enumerators were subjected to a very intensive training covered both classroom discussions and practical field demonstrations. Changes introduced in the scope and coverage, methodology, procedures, concepts and definitions, content of

questionnaires were explained and discussed. It also covered aspects of work of the enumerators, general conduct of the census, filling of questionnaires, practical measurement of fields, crop cutting experiments and weighing of fields. The last day of training was used for distribution of census equipment and materials including questionnaires and manuals of instruction.

Interviews

Villagers were always pre-occupied and suspicious. It was enumerator's duty to win their confidence and to establish good rapport with them.

Questions or information needed from the respondents about crops were systematic, therefore enumerators were able to recall, keep consistency and calculate where necessary. Questions were asked one by one and directly in a way that the enumerator did not lead a respondent. Respondents were able to understand and interpreted the questions correctly.

When enumerator asked about the crops planted, he/she also proved by going to the field for verification of the actual crop planted. In case of the mixtures, farmers tend to refer to the predominant crop only. Interview were related to questionnaires on listing of households, listing of fields, used fertilizers and pesticides, crop failures and their causes, demographic characteristics, entire harvest, livestock etc.

When the holder or head of household was not available at the time of the enumerator's visit, a member who was familiar with the operation i.e. a member who was 18 years and over were asked the questions. But if the interview had not been conducted at all, it postponed to a date that the member of the family was available and the date that was within the survey period, usually called call-backs.

Data Collection

In some PSUs, some village names as listed in the population census of 2006 were found to be different from the names reported to the enumerators on their first and subsequent visits in the PSU.

These differences arose mainly because of:

- The villages have been given new names.
- Villages have been split up into parts, one of which retained the original name and the other assumed a new one.
- Completely new villages have been sprung up after the 2006 population census.

During the training session, the possible changes were explained to the enumerators (FAs), who were asked to probe and make sure that they had identified and delimited the PSU fully and correctly.

In cases in which PSU as listed in the 2006 population census included a village or villages actually outside the physical boundaries, no attempt to delimit to its actual physical boundaries because the selection of PSU was made with probability to proportion size. Enumerators reported complicated cases to the supervisory officer for solution. Within each PSU, the enumerators had to move in some methodical order to minimize travelling and the chances of skipping any household or village within the selected PSU. The Field Officer, Senior Field Officer and the Supervisory Officer from the headquarters moved around extensively to check on the observance of boundaries and

villages to assist enumerators where problems in the interpreting the maps and description arose.

Each enumerator had first reported themselves to the chief or headman immediately when entering the village. They introduced to chief/headman, what authority they represented, the purpose of the visit and their future visit during the census year and information required to remain in the village for the duration of the census period. The chief provided guides to conduct enumerators from household to household. Heads of households or their representative gave the required information to the enumerators to their best of their knowledge. When enumerator finished interviews from one village, he/she sent message to the next village on their schedule notifying the chief/headman on his/her next visit.

Listing of households was made prior to data collection in order to select households. Listing of households was conducted by visiting each household in a systematic way and the information was recorded as it was obtained. All households in the last village of the PSU were listed last. The listing operation was thoroughly checked by Senior Field Officers and other supervisors from the Bureau's headquarters who extensively moved around the areas to scrutinized listing questionnaires.

On completion of the listing of households in each PSU, the completed questionnaires were collected by Supervisors and sent them to headquarters for identification, stratification of agricultural and non-agricultural households and selection of households in each PSU in accordance with sampling procedures were made.

Area Measurement

All fields operated by the sampled households were measured for the two seasons of the year, summer and winter. The method used for area measurement was described in the manual of instructions. For measuring the fields, appropriate bearings and lengths were taken and recorded on the prescribed form and also inserted on the sketch of fields which was drawn on the form in order to facilitate calculation of areas under different crops and fallow areas.

Before measuring the field FA moved around the field to decide the best way of measuring;

These fields included

- Fields belonging to the household and being cultivated by households
- Fields belonging to the households but temporarily fallow
- Fields belonging to the households but cultivated by the household in partnership with others
- Kitchen gardens that were normally small piece of land close to the house
- Fields not belonging to the household but cultivated by the selected household (rented in)

Note was taken for not measuring fields which belonged to the sample household but which were wholly operated by another household i.e fields rented out.

When completed the field sketches, measurements and detailed of planted crops and fallow for the sampled households in the PSU for one season, forms were sent to headquarters for calculation of areas and size of holdings.

Storage of the Questionnaires

The completed questionnaires from the field were stored in file folders. Each folder was marked PSU numbers and the number of forms included on the folder that was already done.

Table 4: Enumerators used in the 2009/2010 Agricultural Census

District	Rural Enumerators	Urban Enumerators	FO's	SFO's
Botha-Bothe	9	3	1	1
Leribe	25	7	5	1
Berea	17	2	1	1
Maseru	20	18	5	1
Mafeteng	14	2	2	1
Mohale's Hoek	9	2	2	1
Quthing	11	2	1	1
Qacha's Nek	6	2	1	0
Mokhotlong	7	2	1	1
Thaba-Tseka	12	2	3	0
Lesotho	130	32	22	8

3.8 Field Supervisors

The Field Officers were charged with the responsibility of checking on the teams of enumerators under them to ensure the timeliness, quality and completeness of the different phases of field operations. They assisted in solving field problems uncounted by the enumerators and supplied them from time to time with the necessary census material including questionnaires and equipment. They were required to check all the questionnaires and ensure their completeness and correctness before sending them to headquarters.

The Field Officers had their headquarters located as centrally as possible within their area of jurisdictions. From their headquarters, they supervised the whole of their area and the enumerators working with them knew where to find them in case of problems and difficulties. They kept records of their visits to their different areas and noted progress of field operations in their respective areas and the problems encountered and solutions offered.

It was the supervisor's duty to visit or contact every enumerator periodically to keep himself well informed about the work. He would assist enumerators if they experienced difficulties. During his visit he conducted sample checks of the operations carried out by the enumerator.

Sometimes he had to repeat the operations himself i.e post checking. It was necessary to inspect the enumerator's notebook to satisfy him that the enumerator was making good progress. They were also required to carry out a post enumerators check of field area measurement, livestock inventory, operation and inputs etc., in respect of one randomly selected household of each enumerator and record on a prescribed form the

entries made by enumerator and the entries as they should have been according to his observation and findings.

After having carried out all corrections, he then write his name and date on the form and submit all checked questionnaire to the headquarters for further processing.

3.9 Senior Field Officers

The overall responsibility over the entire field operations to Senior Field Officers stationed at the district level were for monitoring the operation. Depending on the workload, a Senior Field Officer was also required to supervise the work in areas allotted to other colleagues.

The main duty of the Senior Field Officer was to liaise between headquarters and the field. They checked the efficiency of the Field Officers and Enumerators and assisted them in solving problems arising in day operation of the fieldwork in their areas.

The Senior Field Officer and the Field Officer would impart to their Enumerators necessary training and would ensure that they are conversant with their duties before they are posted to their respective PSUs before taking their rounds within the districts they reported at the headquarters to get the background information necessary to plan and execute their detailed supervisory mission in a district.

During the census operation vehicles allocated for each district were used to facilitate all necessary field trips

Finally the Senior Field Officers checked all the returns and satisfied themselves with the accuracy of the work done before submitting them to Headquarters. They dispatched all completed questionnaires to the Headquarters without delay together with their observations and the remarks and the relevant report on completeness of the work. After the census was completed, checked and withdrew all census equipment from Enumerators to be used in the forthcoming censuses and surveys.

Chapter 4: Sampling Plan

4.1 Overview

The sampling plan adopted for the census of Basotho traditional holdings was analogous to the one developed in 1983/84 by BOS for the annual agricultural production surveys. It was an improvement on the plan employed in the earlier annual surveys in as much as certain auxiliary in the 1996 population census was used for deeper stratification of the domain of study.

One major difference between the sampling plan adopted for this census and the preceding annual surveys was that the sample size in terms of number of PSU's was increased in order to increase the precision of the estimates particularly in respect of those items for deeper cross tabulation was planned or which occurred less frequently but for which reliable estimates at districts and zonal level were needed for development planning.

The sample of PSUs constitutes the National Master Sample (NMS), developed by BOS and which will be used even for other surveys.

The essential elements of NMS are:

- Fixed sample of clusters for a maximum period of five years;
- Strong, reliable and full time field organization of enumerators for data collection in the selected clusters (PSUs);
- Firm organization for the supervision and training of enumerators, for the dispatch of materials and collection of questionnaires from the enumerators;
- Central staff at the headquarters in charge of the field organization, development and maintenance of National Master Sample, design and implementation of sample surveys within its framework;
- Computerized system for processing census/survey data collected within the framework of the NMS.

4.2 Survey Design

This chapter presents an overview of the main survey design used for conducting agricultural census.

The data obtained by enumerators through personal interviews with holders by using questionnaire for each holding and also the enumerators measures fields and gather whatever information needed to complete the questionnaire. Sample enumeration was used for which probability sample (of sampling units) was selected and the estimation method for the census characteristics allows the statistical precisions. This requires defining sampling units and their probability of selection from the known frame.

4.3 Sampling Design

4.3.1 Sampling Frame for Rural

A complete enumeration census was too costly and the country had just run the 2006 population and housing census, thus baseline data was available. However, variance was minimized by increasing the coverage of the agricultural census from that of the annual Agricultural Production Survey (APS) by 50 percent (from 80 to 120 PSUs).

A Stratified multi-stage sampling was adopted for the selection of the sample for the census. In the first stage, Primary Sampling Units were selected from an area of enumeration areas (EAs), which were demarcated by Cartography and Survey Methodology Division during the 2006 population census. Construction of PSU sample frame was done by merging two or more adjacent enumeration areas. PSUs were selected with probability proportion to size (PPS), where the number of farming/agricultural households in the PSUs was considered as the measure of size (MOS). About 120 PSUs in the rural areas that covered 2,292 households were selected.

Individual agricultural holdings (farming households) constitute Secondary Sampling Units (SSU) for estimation of land use, crop areas and livestock population. Prior to the selection of ultimate units (agricultural holdings) a list frame consisting of all holdings in the selected PSUs were stratified as follows:

Those with fields and livestock

Those with fields only

Those with livestock only

Those without fields and livestock

Farming household in the rural areas were considered as:

- Household with at least one field, and one cattle or mixed herd of more than three sheep/goats, or more than three sheep or goats.
- Household with at least one field, but with no cattle or three sheep or three goats or three mixed herd of sheep/goats.
- Household with no fields, but with at least one cattle, three goats or three mixed herd of sheep/goats.

Note: Household with no fields, no cattle and less than three sheep or three mixed herd of sheep /goats were excluded in the farming households sampling frame as they were regarded as non-farming households.

In each PSU, about 27 agricultural households were selected through systematic sampling from a list frame of all agricultural households. For estimation of both summer and winter crops yields, 10 fields under specific crops and two sub-plots for sample crop cutting in each selected field form the third and Ultimate Sampling Units respectively. Institutions, prison, schools and project that were within the selected PSUs automatically qualified for data collection.

The fields and/ or livestock were considered as the main factor that determined whether a household should be included in the census frame or not. Fields were enumerated from the holders who were managing them rather than with the owners. Fields belonging to the households but rented out were not included for area measurement and yield

estimation with sample households. But fields which did not belong to the households but were rented in were included. Kitchen gardens belonging to the selected rural farming households (though their contribution to area planted is small) were included in the census. Minimum size of the kitchen garden to be measured was not determined, so every kitchen garden belonged to the selected households was measured.

For estimation of crop yield in each sample PSU, a maximum of fifteen fields under each principal crop were selected with equal probability of total number of each fields planted to same crop.

In each selected field, two circular plots of ten square meters were located randomly and harvested and the produce threshed, dried and weighed.

4.3.2 Sampling for Urban

About 40 urban EAs that covered 600 households were selected. The sampling method used for urban areas was analogous to the one of the rural sampling method except that the selection at the urban is based on EAs rather than the PSUs. In addition, urban extended all the holdings having at least one field or homestead yards (commonly known as kitchen gardens) and livestock was at least as follows: three pigs, three sheep or goats, one cattle. The minimum size of kitchen garden was also not considered for urban household.

Probing and care was taken for the urban households who claimed to have fields in their homes (districts or regions) which were far from urban areas where they were working and residing. In such incidents, separate households were created where the person who was managing those fields was considered from household that owned but in town and not managing. In cases where the respondent was claiming to have no manager on his/her distant field and claim to operate it him/herself by making frequent visits, enumerator was bound to accompany such farmer to the field.

4.3.3 Sampling for Institutions

The agricultural census also included holdings being institutions of different kinds: Missions, Communal farms, Communal gardens, Prison gardens, School gardens Research and Demonstration farms. Such holdings were the selected PSUs or EAs.

- **Prisons;** a total enumeration of prison farms was done irrespective of whether they fall in the selected EAs or PSU or not; in fact, the number of prisons was fairly small in Lesotho. Further all prisons were situated in districts towns, where they could be reached.
- **Schools;** a list frame of all schools was supplied by the Ministry of Education and all school farms in selected PSUs or EAs were enumerated.
- **Communal gardens, research and demonstration farms as well as projects and cooperatives farms;** Communal gardens, research and demonstration farms that were found in the selected PSUs or EAs were enumerated
- **Church missions;** Church missions that were found in the selected PSUs or EAs were enumerated.

4.4 Estimation Procedures

The direct-expansion estimations refer to the way the holding was distributed among the sampling units before they were expanded to the inverse of the sampling fraction.

4.4.1 Notation

The following notations were used in the discussion:

n_h ; Number of selected PSUs in stratum h

n ; Total number of selected PSUs

M_{hi} ; Size of PSU no.i in stratum h according to the information available when the sample of PSU's was taken.

M'_{hi} ; Number of agricultural households in the PSU according to the household listing.

$M_h = \sum M_{hi}$; Size of stratum h

$M = \sum M_h$; Population size

m_{hi} ; Sample size in PSUi

P_{1i} ; Selection probability for PSUi

P_{2i} ; Selection probability for a household in PSu i

R_{hi} ; Raising factor for PSUi in stratum h.

Y_{hij} ; Variable value for household j in PSUi in stratum h

Probability for PSu's(F1); $F1 = n_h M_{hi} / M_h$

Probability for Households (f2)

4.4.2 Raising Factors

Raising factor is the reciprocal of the sampling fraction. It is used to blow up the sample data for the whole population. If for example, the sample were exactly 1% of the population, the sample data would have to be multiplied by 100 to give estimates of the population totals. The raising factors are inverses of the sample selection probabilities. The survey was designed to give (nearly) uniform raising factors, but imperfections in the conduct of the survey may make it necessary to recalculate them. This was done as follows: For each PSU, the Raising Factor (R_{hi}) or Weight (W_{hi}) was calculated as the inverse of the selection probability:

$$R_{hi} = \frac{1}{P_{hij}} = \frac{1}{P_{1i}} \frac{1}{P_{2i}} = \frac{1}{n_h} \frac{M_h}{M_{hi}} \frac{M'_{hi}}{m_{hi}} \quad (1)$$

$$\text{where } P_{hij} = n_h * \frac{M_{hi}}{M_h} \frac{m_{hi}}{M'_{hi}} \quad (2)$$

$$P_{li} \text{ is defined as } P_{li} = n_h * \frac{M_{hi}}{M_h} \quad (3)$$

$$P_{2l} = \frac{m_{hi}}{M'_{hi}} \quad (4)$$

Ideally, $R_{hi} = 100 = 1/0.01$ in all PSU's, but in practice a difference may be found.

The assumption behind the latest correction, the one for missing data, was that the missing data were not systematically different from the other data.

4.5 Area Planted

Totals, like the total area planted with Maize, were calculated as follows:

1. The total was calculated for each PSU through simple summation of the variable in question over all households in the PSU as Σy_{hij} .

2. The PSU totals were weighted together into stratum totals, using the raising Factors R_{hi} :

$$Y_h = \sum_i Y_{hi} = \sum_i R_{hi} \sum_j y_{hij} \quad (5)$$

3. The stratum totals aggregated to the proper level through summation, i.e.

$$Y = \sum_h Y_h \quad (6)$$

Where the summation extends over all strata (for Lesotho totals), or over all strata in a specified district or zone (for district/zone totals).

Similarly to the above totals, the mean value in one PSU was

$$\bar{y}_{hi} = \frac{\sum y_{hi}}{m_{hi}} \quad (7)$$

The mean value within a stratum was estimated by

$$\bar{y}_h = \frac{\sum_i \bar{y}_{hi} R_{hi}}{\sum_i R_{hi}} \quad (8)$$

And the total mean (Lesotho/District/Zone) by

$$\bar{y} = \frac{\sum_h \sum_i \bar{y}_{hi} R_{hi}}{\sum_h \sum_i R_{hi}} \quad (9)$$

Since $\sum_h \sum_i R_{hi} = 1$ equation (9) boils down to :

$$\bar{y} = \sum_h \sum_i \frac{1}{n_h} \frac{M_h}{M_{hi}} \frac{M'_{hi}}{m_{hi}} \bar{y}_{hi} \quad (10)$$

4.6 Crop-cutting data

For the case of crop-cutting data, sampling method used necessitates a slightly different approach to estimation, where the first step above was replaced by:

The (at most) 10 subplot results for each crop were average (after Conversion to kg/ha) within each PSU to obtain

$$\bar{x}_{hi} = \frac{\sum_j x_{hij}}{m_{hi}} \quad (11)$$

This was average yield/ha in the PSU. In the calculation of average yield, field with recorded crop failure were excluded.

The average production per ha was multiplied with the harvested area, i.e $\sum y_{hij}$ of that crop to obtain, after multiplication with the raising factor,

$$z_{hi} = R_{hi} \bar{x}_{hi} \sum y_{hij} \quad (12)$$

These totals were summed as in steps 2 and 3 above to obtain stratum totals and Lesotho (district/Zone) totals, respectively. The harvested area was defined as the measured area of all fields, but where fields with recorded crop failure were excluded.

4.7 Sampling Errors

Sampling errors for some of the estimates provided in the census were calculated using the WesVar. As an example of the magnitude of the sampling errors, calculation of standard errors (SE), confidence interval (CI) and design effect (DEFF) for the estimates of total number of households owning cattle, sheep and goats were made. Estimates for households planted the following crops; maize, sorghum and wheat were also done. These sampling errors were presented at national and districts level. This was done in order to allow users to see the accuracy of the census results at district levels.

4.7.1 Software

WesVar is designed for computing sampling errors for survey data collected using complex designs including multi-stage, stratified and unequal probability sample. It computes estimates that properly reflect complex sampling and estimation procedures. It has several stages in computing the sampling errors. They are as follows;

- Defining the variable, full sample and identification.
- Computing replicates.
- Calculating the sampling errors or variance like standard error, confidence interval (CI), design effects (DEFF), non-response or other adjustments.

The sampling errors were computed using Jackknife n (JKn) replication method. The JKn method is used when the number of PSUs in a stratum is greater than or equal to two. The idea behind replication methods is to calculate the estimate of interest from the full sample as well as each subsample or replicate. The variation between the replicate estimates and the full-sample estimate is then used to estimate the variance for the full sample. The variance estimator, $v(\theta^*)$, takes the form:

$$v(\theta^*) = c \sum_{g=1}^G f_g h_g (\hat{\theta}_g - \hat{\theta})^2 \quad (13)$$

$$h_g = (nh' - 1) / nh',$$

Where;

f_g = population correction factor

h_g = factors

$\hat{\theta}_g$ = the estimate of θ based on the observations included in the g -th replicate,

G = the total number of replicates formed, and

c = a constant that depends on the replication method.

Confidence Intervals

Confidence interval (CIs) which allow users of the data to see the range of possibilities for the true parameter value, were computed by the following formula;

$$95\% \text{ CI} = \bar{y}_h \pm 1.96 * SE(\bar{y}_h) \quad (14)$$

where, 1.96 is the Z-value obtained from the normal distribution and this Z-value is expressed as

$$Z = \frac{\bar{y}_h - \mu_{y_h}}{\partial_{\bar{y}_h}} \quad (15)$$

where, \bar{y}_h were the estimates of the households with livestock and crops,

μ_{y_h} is the population estimate and

$\partial_{\bar{y}_h}$ is the standard error of the estimate

$SE(\bar{y}_h)$ was the standard error of the estimate and was given as

$$SE(\bar{Y}_h) = \sqrt{V(\bar{Y}_h)} \quad (16)$$

$$V_{\text{tot}}(\bar{Y}_h) \text{ is given as } V_{\text{tot}}(\bar{Y}_h) = \frac{1}{n_h(n_h-1)} \left[\sum_{i=1}^{n_h} (y_{hi} - \bar{Y}_h)^2 \right] \quad (17)$$

Design Effect

The Design Effect (DEFF) was used as a measure of precision. It simply compares the variance of the estimator under the census design (Multi-Stage Stratified Cluster Sample Design) with that of an equivalent SRS design. DEFF is given by the following expression.

$$\text{DEFF (Design)} = \frac{\text{Variance of the estimator under survey Design}}{\text{Variance of the estimator under SRS}}$$

DEFF values were computed in order to measure increase in variance due to design effects. These values of DEFF were expected to lie below 10 for the estimator to be considered to have minimum variance.

The estimator in the equation 18 gives the combined variance that is between and within PSUs and the decomposition of these two components is as follows.

Combined Variance (18)

Variance between PSUs $V_{bet}(\bar{Y}_h)$	$\frac{1}{n_h} \left[S_{hi}^2 - \frac{1}{n_h} \sum_{i=1}^{n_h} \left(\frac{M_h}{M_{hi}} \right)^2 \frac{M_{hi}'^2}{m_{hi}} \frac{M_{hi}' - m_{hi}}{m_{hi}} S_{wit}^2 \right]$
Variance within (between SSUs) PSUs $V_{wit}(\bar{Y}_h)$	$\frac{1}{n_h} \sum_{i=1}^{n_h} \left(\frac{M_h}{M_{hi}} \right)^2 \frac{M_{hi}'^2}{m_{hi}} \frac{M_{hi}' - m_{hi}}{m_{hi}} S_{wit}^2$
Stratum(Zone/Districts) Variance $V_{tot}(\bar{Y}_h)$	$\frac{1}{n_h(n_h-1)} \sum_{i=1}^{n_h} (\bar{Y}_{hi} - \bar{Y}_h)^2$

$$S_{hi}^2 = \frac{1}{(n_h-1)} \left[\sum_{i=1}^{n_h} (\bar{Y}_{hi} - \bar{Y}_h)^2 \right]$$

And

$$S_{wit}^2 = \frac{1}{m_{hi}-1} \left[\sum_j y_{hij}^2 - \left(\sum_j \bar{Y}_{hi} \right)^2 \right]$$

DISTRICT	ESTIMATE	STDERROR	LOWER 95%	UPPER 95%	DEFF
	8 730	2800.42	3178.98	14280.82	
Botha-Bothe	(6.65)	(2.18)	(2.33)	(10.97)	10.19
	20 789	5209.23	10463.09	31114.27	
Leribe	(15.84)	(3.87)	(8.17)	(23.5)	14.957
	17 003	4116.44	8843.92	25162.94	
Berea	(12.95)	(3.13)	(6.75)	(19.16)	11.566
	20 149	4707.25	10817.92	29479.08	
Maseru	(15.35)	(3.56)	(8.26)	(22.44)	13.106
	16 304	4272.50	7835.51	24773.17	
Mafeteng	(12.42)	(3.21)	(6.07)	(18.77)	12.582
	10 778	3452.03	3935.01	17620.03	
Mohale's Hoek	(8.21)	(2.64)	(2.98)	(13.44)	12.32
	9 635	3422.88	2850.23	16419.71	
Quthing	(7.34)	(2.56)	(2.23)	(12.45)	13.025
	4 810	2790.98	-722.7	10341.72	
Qacha's Nek	(3.66)	(2.12)	(-0.54)	(7.87)	16.988
	12 780	4283.35	4290.01	21270.67	
Mokhotlong	(9.74)	(3.21)	(3.38)	(16.09)	15.577
	10 294	3241.70	3868.38	16719.62	
Thaba-Tseka	(7.84)	(2.51)	(2.87)	(12.82)	11.611
National	131 271	4 646.77	122 060.48	140 481.9	N/A

4.7.2 Description of Estimates, Standard Error, 95% Confidence Interval (CI) and Design Effect (DEFF) for households with Livestock.

Standard Errors, Confidence intervals and DEFF for households with cattle and sheep at national and district level were computed. Table 1 shows estimated number of agricultural households with one or more cattle as 131 271. Leribe had the highest number of households with cattle (20 789) while Qacha's Nek was lowest with 4 810 households. Standard error ranged between 2.18 and 3.87 for all districts implying The DEFF for all districts was above 10 percent showing high variance in the estimates for all districts. Botha Bothe was the only district closest to 10 while Qacha's Nek was furthest.

Table1: Cattle; Estimates, Standard Errors (SE), 95% Confidence Interval (CI), and Design Effect (DEFF)

Table 2 shows number of households with sheep by district. Mokhotlong had the highest number of households owning sheep with 15.1 percent followed by Mafeteng with 12.3 percent while Qacha's Nek was the lowest with 4.0 percent. The confidence interval at national level was between 54 737 and 69 486 at 95% level. Standard error was lowest in Botha-Bothe at 1.92 percent while highest for Mokhotlong (5.33 percent). DEFF

showed high degrees of precision in all districts with the exception of Mokhotlong and Qacha's Nek with 13.99 and 10.95 percent respectively.

Table 2: Sheep; Estimates, standard errors (SE), 95% Confidence Interval (CI) and Design Effect (DEFF)

DISTRICT	ESTIMATE	STDERROR	LOWER 95%	UPPER 95%	DEFF
	2 954	1166.62	641.63	5266.51	
Botha-Bothe	(4.76)	(1.92)	(0.96)	(8.56)	5.1
	6 116	1900.35	2349.45	9883.09	
Leribe	(9.85)	(3.12)	(3.66)	(16.03)	6.92
	6 590	1776.56	3068.34	10111.24	
Berea	(10.61)	(2.84)	(4.98)	(16.24)	5.36
	6 784	1852.86	3111.47	10456.87	
Maseru	(10.92)	(3.08)	(4.82)	(17.03)	6.14
	9 127	2485.17	4201.36	14053.42	
Mafeteng	(14.7)	(3.77)	(7.21)	(22.18)	7.16
	7 631	2573.51	2530.04	12732.32	
Mohale's Hoek	(12.29)	(4.02)	(4.32)	(20.25)	9.43
	5 280	1994.88	1326.22	9234.62	
Quthing	(8.5)	(3.21)	(2.13)	(14.87)	8.36
	2 455	1591.17	-699.27	5608.67	
Qacha's Nek	(3.95)	(2.57)	(-1.14)	(9.04)	10.95
	9 405	3481.00	2504.96	16304.86	
Mokhotlong	(15.14)	(5.33)	(4.58)	(25.7)	13.92
	5 769	2175.63	1456.08	10081.04	
Thaba-Tseka	(9.29)	(3.56)	(2.24)	(16.34)	9.46
National	62 111	3 720.20	54 737.38	69 485.54	N/A

Table 3 presents the number of households with at least one or more goats. The table shows that about 58 035 households owned goats. It was observed that Maseru had more of the households owning goats followed by Mokhotlong and Quthing with 14.39, 14.0 and 13.99 percent respectively. The standard error ranged between 1.81 and 4.92 percent for all districts. DEFF for all districts showed high precision except for Quthing and Mokhotlong with above 10 percent.

Table 3: Goats; Estimates, standard errors (SE), 95% Confidence Interval (CI) and Design Effect (DEFF)

DISTRICT	ESTIMATE	STD	LOWER 95%	UPPER 95%	DEFF
		ERROR			
	2 391	1037.17	335.34	4447.06	
Botha-Bothe	(4.12)	(1.81)	(0.53)	(7.71)	4.81
	5161	1647.26	1895.46	8425.76	
Leribe	(8.89)	(2.87)	(3.2)	(14.59)	5.90
	6 003	1640.10	2751.77	9253.71	
Berea	(10.34)	(2.79)	(4.82)	(15.87)	4.85
	8352	2160.02	4070.4	12633.46	
Maseru	(14.39)	(3.75)	(6.96)	(21.82)	6.60
	4 545	1470.07	1630.81	7458.67	
Mafeteng	(7.83)	(2.5)	(2.87)	(12.79)	5.03
	7 416	2558.22	2345.57	12487.25	
Mohale's Hoek	(12.78)	(4.29)	(4.28)	(21.28)	9.55
	8 117	2976.22	2217.89	14016.65	
Quthing	(13.99)	(4.92)	(4.24)	(23.73)	11.63
	2 549	1300.76	-29.58	5127.06	
Qacha's Nek	(4.39)	(2.27)	(-0.11)	(8.89)	7.12
	8 126	2905.88	2365.74	13885.66	
Mokhotlong	(14.0)	(4.85)	(4.38)	(23.62)	11.33
	5 376	1690.20	2025.76	8726.28	
Thaba-Tseka	(9.26)	(3.08)	(3.16)	(15.37)	6.54
National	58 035	3 247.908	51 597.44	64 473.28	N/A

4.7.3 Description of Estimates, Standard Error, 95% Confidence Interval (CI) and Design Effect (DEFF) for households planted Maize, Wheat and Sorghum.

The Standard errors, confidence intervals and DEFF for households which had planted maize, wheat and sorghum at national and districts level were computed. Table 4 presents number of households that planted maize by district. About 253 293 households had planted maize country wide, whereby Leribe was the highest with 17.57

percent and Qacha's Nek was the lowest with 3.01 percent. When comparing standard errors for the districts Leribe had the highest percent of 4.48 followed by Mafeteng with 3.45 percent while Quthing was the lowest with 1.26 percent. Design effect was extremely high for all districts.

Table 4: Maize; Estimates, standard errors (SE), 95% Confidence Interval (CI) and Design Effect (DEFF)

District	ESTIMATE	STDERROR	LOWER 95%	UPPER 95%	DEFF
Botha-Bothe	17 508	6889.02	3861.83	31153.49	30.05
	(6.91)	(2.73)	(1.51)	(12.31)	
Leribe	44 494	11969.25	20785.51	68203.09	36.03
	(17.57)	(4.48)	(8.7)	(26.43)	
Berea	33 995	8543.24	17072.39	50917.43	25.29
	(13.42)	(3.36)	(6.77)	(20.08)	
Maseru	37 885	9061.87	19935.55	55835.17	26.58
	(14.96)	(3.6)	(7.82)	(22.1)	
Mafeteng	32 796	8894.997	15177.04	50415.6	27.56
	(12.96)	(3.45)	(6.11)	(19.79)	
Mohale's Hoek	23 347	6779.87	9917.31	36776.53	22.32
	(9.22)	(2.68)	(3.91)	(14.52)	
Quthing	9 537	3112.85	3371.48	15703.38	11.4
	(3.77)	(1.26)	(1.27)	(6.26)	
Qacha's Nek	7 646	3987.97	-253.83	15544.97	22.32
	(3.02)	(1.58)	(-0.12)	(6.16)	
Mokhotlong	20 985	7748.65	5636.42	36333.6	31.03
	(8.28)	(3.01)	(2.32)	(14.25)	
Thaba-Tseka	25 101	7061.33	11114.21	39088.49	22.8
	(9.91)	(2.8)	(4.36)	(14.46)	
National	253 294	11 603.31	230 310.9	276 278.76	N/A

Table 5 shows the number of agricultural households that had planted wheat. The total number of households that had planted wheat was 29 571 for the whole country and Berea was the only district where wheat was not planted. Mokhotlong had the highest Standard error of 13.94 percent while Mafeteng had lowest (0.49 percent). DEFF ranged between 1.05 and 23.61 for all districts.

Table 5: Wheat; Estimates, Standard Errors (SE), 95% Confidence Interval (CI) and Design Effect (DEFF)

District	ESTIMATE	STDERROR	LOWER 95%	UPPER 95%	DEFF
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	442	441.98	-433.5	1317.46	
Botha-Bothe	(1.49)	(1.52)	(-1.52)	(4.51)	4.67
	2 040	1352.56	-639.11	4719.23	
Leribe	(6.9)	(4.75)	(-2.54)	(16.31)	10.41
Berea	0	0	0	0	0.00
	3 729	1816.97	130.02	7328.14	
Maseru	(12.61)	(6.48)	(-0.22)	(25.45)	11.28
	197	139.34	-78.96	473.06	
Mafeteng	(0.67)	(0.49)	(-0.3)	(1.63)	1.05
	2 237	1431.05	-597	5072.28	
Mohale's Hoek	(7.57)	(5.01)	(-2.36)	(17.5)	10.64
	1 299	946.99	-576.53	3175.07	
Quthing	(4.39)	(3.29)	(-2.13)	(10.92)	7.64
	2 955	1932.08	-872.51	6781.67	
Qacha's Nek	(9.99)	(6.72)	(-3.31)	(23.3)	14.85
	12 433	5503.57	1531	23334.02	
Mokhotlong	(42.04)	(13.94)	(14.43)	(69.6)	23.61
	4 239	1398.94	1468.13	7010.21	
Thaba-Tseka	(14.34)	(5.84)	(2.77)	(25.9)	8.22
National	29 571	5 045.44	19 577.29	39 565.39	N/A

Table 6 presents the number of households that had planted sorghum. The mountainous districts were observed to be the least among districts that planted sorghum with 5.12, 4.00 and 2.31 percent for Mokhotlong, Thaba-Tseka and Qacha's Nek respectively. Smaller standard errors were observed for the mountainous districts ranging from 1.57 to 2.5 percent. The DEFF was 7.57 percent and was also less than 10 percent for most of the districts with the exception of Quthing, Mafeteng and Botha-Bothe.

Table 6: Sorghum; Estimates, Standard Errors (SE), 95% Confidence Interval (CI) and Design Effect (DEFF)

District	ESTIMATE	STDERROR	LOWER 95%	UPPER 95%	DEFF
	4 790	2123.787	583.17	8996.79	
Botha-Bothe	(8.07)	(3.54)	(1.06)	(15.07)	10.01
	8 403	2075.7	4291.91	12515.03	
Leribe	(14.15)	(3.58)	(7.06)	(21.24)	6.26
	8 397	2360.932	3720.61	13073.71	
Berea	(14.14)	(3.98)	(6.25)	(22.03)	7.75
	8 272	2389.311	3539.51	13005.03	
Maseru	(13.93)	(4.01)	(5.98)	(21.88)	7.96
	8 877	3017.692	2899.23	14854.17	
Mafeteng	(14.95)	(4.85)	(5.34)	(25.55)	10.96
	8 535	2435.748	3710.52	13360.02	
Mohale's Hoek	(14.37)	(4.05)	(6.35)	(22.4)	7.91
	5 324	2579.849	213.51	10433.89	
Quthing	(8.96)	(4.21)	(0.62)	(17.31)	12.89
	1 373	972.747	-553.46	3300.2	
Qacha's Nek	(2.31)	(1.64)	(-0.94)	(5.57)	7.10
	3 044	1490.747	90.77	5996.53	
Mokhotlong	(5.12)	(2.47)	(0.22)	(10.02)	7.46
	2 374	913.976	563.64	4184.46	
Thaba-Tseka	(4.00)	(1.57)	(0.89)	(7.1)	3.80
National	59 389	4 497.505	50 480.93	68 298.31	N/A

4.8 Non-Sampling Errors

The agricultural Census like other surveys is prone to non response errors. There are many possible causes of non-sampling errors, which are discussed below.

4.8.1 Enumerators

The enumerators were poorly informed of the objectives of the census and not equipped in its technical details because of lack of qualifications and inadequate training. They were not sympathetic towards the respondent and did not have enough patience with the respondent; they were liable to record grossly inaccurate information. In extreme cases non-sampling errors caused by fictitious data by going through a hurried procedure of an interview or without taking any interview at all. Also due to the terrains of the country some areas are not easily accessible, so some of the Field Assistant themselves should organize their own transport using their own money thereafter their claims/payment delayed which affect the next activity.

The solutions to control such errors were through careful training an efficient supervision, pre-coding the questionnaire as to reduce the risk of enumerators committing errors either mechanically or through misinterpretation of the respondent's information. Therefore the questionnaires were designed in a way that they provided as much internal checks as possible, e.g. number born and male of stock of breeding age. The method used for area measurement was self-correcting, i.e. the method provides an internal check on the quality for fieldwork by checking it regularly for consistency.

4.8.2 The respondent

There are factors potentially responsible for the respondent; firstly farmer's lack quantitative understanding of their business, also are not keeping their accounts as a result cannot give precise data for the operations correctly. secondly sensitization of Agricultural Census was inadequate more especially to the people at the remote areas, therefore households were reluctant to provide information as were expecting to get some donations/ subsidies from the government like seeds, tractors etc. Households even show apparent cooperation as suspecting Field Assistant as Police/Government investigators and government will impose taxes on their produce or procure it compulsorily or even confiscate their land or livestock thereby some of the information provided was inaccurate.

Chapter 5: Data Processing

5.1 Systems document

The BOS Agriculture Unit has microcomputer equipment servicing other surveys and administrative activities. The 1999/2000 Agricultural Census (AC) was designed for processing using microcomputers with Statistical Package for Social Scientists (SPSS) version 10.0. SPSS consists of data builder, data entry station and data analysis.

5.2 Editing and Coding

Coding and editing instructions were written before data entry. In most of the questionnaires items were pre-coded. Disaggregating of livestock species by age and sex is the typical example of pre-coded questionnaire. There was however some entries, which required clerical coding at the processing stage and the coders, were trained and supervised for this purpose. Coding supervisors or subject matter specialist resolved document problems.

The general types of errors to be found in editing were:

- cases in which an entry is required for an item but none has been made i.e. omissions.
- cases in which the entries in two or more items were not consistent with each other, such as number of male cattle two years and above which should tally with castrated and un-castrated stock of breeding age, i.e. inconsistency.
- cases in which entries were beyond the reasonable limits of an item, such as number of milk production, which may appear to be impossible, i.e. unreasonable entries.
- instances in which, for example a code “3” appears where provision has been made only for codes 1 and 2, i.e. impossible entries.

In all cases questionnaires, manual checking was done for identification particulars of all households, i.e. district, PSU, zone, household number, name of head, field number, crop, season, chief and village names etc, then the coder would check if district, zone, PSU are the same as in the cluster list provided.

Form AC-1: - Household listing, they checked that the sex of every household head

had been recorded and, if not, code sex according to the name e.g. Thabo usually belongs to male, while Mathabo will be female.

Form AC-2: - Household composition, in this form checking was on relationship of household to the head of the household. The age of a child should not exceed that of the parent, main occupation should be filled in for those who are 10 years and over, residence for the past six months is asked for household head only.

Form AC-3: - Field listing, they would make sure that all fields were listed in an ascending order, that they had field location and finally that all columns are filled for each field.

Form AC-4: - Area measurement, they were to check that area is given to each field, and if planted to more crop (crop mixture) that each portion had its separate area. Red pen was used to give crop code.

Form AC-6:- Operation and inputs, here they were to check that at least one type of operation, one type of weeding and one type of inputs is recorded per each field. Amounts in kg were calculated from local units and filled in by the coders using red pens.

Form AC-7:- Sample crop cutting, here they were to check that a crop is given for each field, that either dry or raw or both weight were given. Crop code was entered by a red pen.

Form AC-8: - Farmer's yield, entire harvest is given in units size and kind. Therefore they used red pens to give the crop and entire harvest in kg, i.e. column 8 = col: 4 x 6.

Form AC-9:- Crop failure, codes for failure were listed at the bottom of the questionnaire, and at least one reason for failure was coded.

Form AC-10:- Livestock, here the codes were to check that the number of male and female animals in each age group tallies with total number of animals, and that the totals obtained by adding the numbers in each age group are consistent with the totals.

Entry of the data was made on SPSS Data Entry Station. Each of the data entry staff stored their data in batch file.

5.3 Validation

After data entry, the different files for each questionnaire were transferred to SPSS format, and were merged. The files were sorted in order of PSU identification and household identification, and any other identification variables might exist in the file (person id, etc). Validation checks were done in SPSS. These were different files, but the validation in all cases included:

- Records that after sorting were completely identical to the previous record in the file were deleted as being duplicate entries.

- Records that had the same identification information as the previous record, but with different variable values, were listed as being suspected duplicates. These were manually checked against the questionnaires.
- Records that had a PSU identification that was not on the list of PSU's were listed and marked for manual checking.
- List of PSU's for which no data were available in the file were prepared, so that completeness of data could be assured.
- Validity checks of important variables were undertaken. These checks included range checks (e.g. the only permitted codes for sex were M and F), consistency reasonable (e.g. each household must have a head), and checks that the results were reasonable (e.g. fields areas larger than 4 ha might exist, but areas were listed for checking against the questionnaires).
- The response rate, in terms of number of households, was calculated for Each file. This had two purposes:
 - to assess the completeness of the data.
 - to make any adjustments in the raising factors which might be necessary because of missing data. The raising factors were calculated according to section 5.4.
- The sequence of data were checked in many files, e.g. in the household members file, members should be listed in sequential order, 1,2,3,.... If in a household members no.1,2,3 and 5 were present, the whereabouts of members no.4 was checked in the questionnaires.

In practice, the above editing process was repeated several times for each file until the data were considered to be ready for tabulation.

5.4 Tabulation Plan

The tabulation plan outlines the presentation of information obtained from the agricultural census for the data users. It described in detail the structure of the presentation of the summarized data, with an indication of the priorities, so that data processing staff can plan their work, and users can plan further analysis of the agricultural sector data.

The tabulation plan was based on detailed discussions with data users and required cross-tabulations. In particular, the tabulation plan indicates proposed tabulations by stakeholders, among were the Ministry of Agriculture and Food Security, Ministry of Trade and Industry, Ministry of Natural Resources (Meteorology) and Disaster Management Authority (DMA), taking into account the need to limit the number of tables and limitations in producing tables for small areas.

Preparation of the Tabulation Plan

In setting up a tabulation plan for an agricultural census, consideration to the type of information needed by the country as well as by stakeholders were taken. The

importance of forming a group of experts drawn from user organizations for formulating the questionnaire had been discussed in detail in chapter two. The group involved professionals who knew the agricultural situation and its problems and who had the expertise to identify data needs. The tabulation plan was comprehensive and the classical presentation was cross-tabulated.

The tables were prepared using the custom table procedure in the SPSS package. Raising factors as described in section 5.4, and estimation formulae discussed in section 5.5 were used. The SPSS output was transferred to Microsoft Word to produce a print-ready copy for printing the publication.

5.5 Publications

Planned Publications

The results from the census will be presented in four volumes:

- Volume I: RURAL HOUSEHOLDS AND CROPS STATISTICS
- Volume II: RURAL LIVESTOCK STATISTICS
- Volume III: URBAN CROPS AND LIVESTOCK STATISTICS
- Volume IV : COMMUNITY PROFILE
- Volume V: TECHNICAL REPORT

Volume I. Rural Household and Crops Statistics: The report presents mainly household characteristics with some key demographic and socio-economic variables including sex, education, age, occupation, sources of livelihood and residential status being used at different levels such as household heads and to some extent members of the household. Results relating to fields and land utilization for crops and fruit trees are also provided. Included also are the types of field operations and utilization of inputs. Ownership of farm equipment, building and labour are incorporated in this report.

Volume II. Rural Livestock Statistics: This report contains results on the rural livestock sector consists of cattle, sheep, goats, horses, donkeys, mules, dogs, pigs and chickens. Social status of shepherds was discussed also.

Volume III. Urban Crops and Livestock Statistics: This report comprises of aspects in volume 1 and 2 but in urban areas. Information summarized is on garden operations such as soil preparation and the application of inputs since there are less or no fields in urban areas.

In these publications (Volumes I, II and III) tables derived from all parts of the different questionnaires are presented. Time series from past censuses and surveys are also shown. Most of the tables are presented by zone and district. Graphic presentation showing the present and the past trends are included in this report.

Volume IV: This report gives information and profile of each community councils for the entire country. This includes; agricultural facilities, health facilities and educational facilities etc. It also shows infrastructures and developments made in each community

councils. It further explains criminal records that were reported either in a police station or to the chief.

Volume V. Technical report: This report gives the history background of the past censuses, the annual agricultural production survey, and other surveys. It goes on explaining the objectives of the census, its implementation, planning, concepts and definitions used during the census. The sampling and estimation procedures and techniques, staffing and technical procedures used in data collection are described. The main objective of this report is to document the technical aspects of the census, to make principal users aware of the possibilities and problems with the census data.