

PROVISIONAL MILITARY GOVERNMENT
OF SOCIALIST ETHIOPIA

MINISTRY OF AGRICULTURE
AND FORESTRY DEVELOPMENT

C R O P P R O D U C T I O N
S U R V E Y

1975/76

(1968 E. C.)

(REPORT)

Statistics Division

Planning and Programming Department

ADDIS ABABA, APRIL 1976

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PREFACE

Adequate agricultural statistics are basic requirement to national agricultural development objectives. They provide information on the level of nutrition and standard of living of rural population, on production and distribution of food and agricultural products, etc. All these data are essential for sound and proper national planning.

The role of adequate agricultural statistics is quite recognized by the Ministry of Agriculture and Forestry Development. However, in spite of the efforts made by the Ministry to improve and develop agricultural statistics, the progress is not comparable to the desired objectives. To speed up the progress in this field, it is necessary to conduct the first census of agriculture as benchmark for all agricultural surveys, and prepare a long-term programme of food and agricultural statistics.

Users of agricultural data from different Government institutions are mainly interested in crop production statistics. To fulfil the demands of the users, the Planning and Programming Department of the Ministry of Agriculture and Forestry Development has conducted a national crop production sample survey.

The crop production sample survey was conducted as nation-wide sampling survey and about 5,000 private holdings were randomly selected for interviewing. Data on area under major crops and yield of these crops were obtained by area measurements and crop-cutting experiments respectively.

This report comprises of six chapters and three annexes. The first two chapters are devoted to a description of the objectives of the survey, its organization, progress of field work, methodology of the survey, edi-

ting and processing of the data. The last four chapters deal with the survey results, which are generalized on the country level. Chapter III deals with the area under major crops, their yield and production which were estimated according to the data obtained from area measurement and crop-cutting experiments respectively. Chapter IV is devoted to distribution of holdings by size, land utilization, fragmentation of holdings, and use of fertilizers. Chapter V presents comparisons of area under major crops, yield and production of these crops in years 1974/75 (1967 E.C.) and 1975/76 (1968 E.C.). Chapter VI deals with analysis of sampling and non-sampling errors in the survey. Annex I presents the results of the survey by six regions; annex II - training programme, annex III - gives a list of survey personnel. Two forms at the end of the report are attached: Form CP-I Crop Production Questionnaire 1975/76, and Form CP-MS Field Area Measurement.

ACKNOWLEDGEMENTS

The Planning and Programming Department is grateful to the Central Statistical Office for providing one member to the Statistical Working Group and six field supervisors; Provincial Managers of Hararghe and Gojam for their assistance during the survey. The Department is also grateful to all regional and field supervisors, and specially to Ato Ketema Itecha (CSO) and Ato Ephraim Erana (PPD), for the successful accomplishment of their duty.

The Planning and Programming Department appreciates the assistance provided by the FAO and UNDP (under Project ETH/73/004) and special thanks is due to Dr. J. Kordos for his unsparred efforts shown in conducting the survey.

In editing and processing of the data, extra ordinary effort was exerted by Ato Nafe Mohammed and Ato Ephraim Woudneh, the Department is grateful to these two individuals.

Finally the Department would like to express its deepest thanks to all survey personnel, especially enumerators and their guides, without whose efforts this whole survey could not have been successful (see Annex III for complete list of survey personnel).

Wondwosen Messele

Addis Ababa, April 1976

For Acting Head
Planning and Programming Dept

Chapter I

OBJECTIVE AND ORGANIZATION OF THE SURVEY

1.1 Introduction

This chapter deals with the objective of the survey, population under study, method of data collection, and organization aspects of the survey.

Based on the experience gained last year / [1] /, this survey is designed to provide national level estimates of area, yield and production of major crops grown in the country.

Out of the total number of about 570 weredas in the country 452 are of agricultural importance. However, due to inaccessibility and security reasons, only 395 weredas agriculturally important were considered for the survey.

The methodology and organization for the survey was prepared by the Statistical Working Group (SWG) which was established in 1974 by the Planning and Programming Department (PPD) of the Ministry of Agriculture and Forestry Development (MOAFD).

To facilitate the conduction of the survey and to attain the results expected all the provinces (excluding Eritrea) were divided into six survey regions. Eritrea was not covered in this survey for security reasons.

Adequate training programme was conducted in the Headquarters and other regional offices to assure that the supervisors and enumerators master all aspects of the field work of the survey. Moreover, a special team was set up for editing and processing the data.

A total amount of Eth. \$151,406, was expended to carry out the survey. This amount does not include salary of permanent employees and depreciation of vehicles and equipments.

1.2 Objective of the Survey

The main objective of the survey is to get an estimate of reasonable precision on: area, yield and production of the major crops grown in the country.

It also provides information on:

- 1) Number of holdings
- 2) Size of holdings
- 3) Land utilization
- 4) Type of land
- 5) Use of irrigation
- 6) Use of fertilizers
- 7) Membership of farmers association and cooperatives.

Ultimately, it provides a national level estimate of the above mentioned characteristics for 1975/76(1968 E.C.) Main Harvest season (Meher).

An attempt is also made to provide regional level estimates of the characteristics mentioned above; however, as the primary aim of the survey is to get estimates at national level, this attempt should be considered as a by product of the survey.

The scope of the survey is limited to provide area and production of the estimates major crops cultivated by private holders. State farms and cooperatives are not included.

The major crops covered are:

- | | |
|----------------|--------------------|
| 1) Teff | 9) Chick peas |
| 2) Barley | 10) Lentils |
| 3) Corn | 11) Haricot beans |
| 4) Wheat | 12) Linseed (flax) |
| 5) Millet | 13) Neug (Niger) |
| 6) Sorghum | 14) Rape seed |
| 7) Horse beans | 15) Sesame |
| 8) Field peas | |

1.3 Population Under Study

The population under study are the private holdings in the agriculturally important weredas. There are about 570 weredas in the nation. Out of this total number 452 weredas are of agricultural importance.

Therefore, the number of weredas considered for this study was 452. However, due to inaccessibility and security reasons 57 weredas are dropped. This reduces the population under study to the private holdings in the remaining 395 weredas.

Fifteen major cereal crops grown in these weredas were considered for this survey.

1.4 Administrative Responsibility and Finances

The development of the methodology, conduction of the survey and the analysis of the data were the sole responsibility of the Planning and Programming Department in the Ministry of Agriculture and Forestry in collaboration with Central Statistic Office.

The over all administration and execution of the survey was fully under the head of the Planning and Programming Department. The Statistical Working Group

(SWG) which was established in 1974 prepared the methodology and organization of the survey.

The Statistical Working Group (SWG) consisted of one FAO statistician, one survey coordinator, three PPD staff members and one CSO staff. EPID and CSO have also cooperated in supplying equipment and field personnel.

About \$151,406 was expended to carry out the crop sample survey. This amount of fund was a part of the budget allotted for carrying out crop sample survey by the PPD/MOAF. The lump sum allocated to cover different costs incurred in conducting the survey such as per diem, fuel, maintenance of vehicles and partly equipment costs. The salary of permanent employees, depreciation of the cars and equipment is not included in the estimated cost. The break down of the cost by items it as follows (in Eth. \$):

Per diem	106,552
Fuel	24,873
Maintenance	9,529
Transport	6,808
Miscellaneous	3,644
	<hr/>
T O T A L	<u>151,406</u>

1.5 Questionnaires, Forms and Instruction Manuals - Methods of Data Collection

As a result of the experience gained from last year's Agricultural Sample survey, we were able to modify and simplify the questionnaires, forms and instruction manuals as much as possible in order to minimize non sampling errors.

The questionnaires are designed to get an objective crop production estimate for the whole nation. It is expected that the information gathered from these questionnaires and forms will satisfy all the users of this type of statistics.

Different types of questionnaire and forms were used to collect the necessary data.

One questionnaire for interview (CP - I), two forms for field measurement (CP - MS, CP - M) and one form for crop cutting (CP - C) were used.

CP - I inquires the following information:

- 1) General characteristics of parcels, fields and production
- 2) Land use, type and size of holdings
- 3) Membership of Farmers' Associations and cooperatives
- 4) Use of irrigation and fertilizers

The method of collecting this information was by interview. In addition conversion list of areas and production were used to convert local units into standard metric units / [4] / .

Form CP-C This form records the weight of yield harvested from a 4m x 4m plot. Two plots (4m x 4m) are cut from each field. The weight of each plot is recorded separately after the threshing. Threshing is done as much as possible in the manner the farmers follow. After two weeks of drying the grain harvested for each plot is weighted again to determine the actual weight. The main purpose of the crop cutting experiments is to get an objective yield of each crop and determine the correction coefficients.

Form CP-MS is a graph paper where a sketch of the sampled field is drawn using appropriate scale to determine the actual area of the field.

Form CP-M This form records the actual area determined in Form CP-MS and area estimated by farmer. By comparing the differences between the two estimates, the degree of over and under estimation can be calculated.

Moreover, three supporting listing forms were used; these forms are:

CPS-1 : records all holders in the selected administrative subdivisions.

CPS-2 : lists the sample of holding selected

CPS-3 : lists the fields in the selected holdings by crop.

Instruction Manuals

Even though an intensive training was provided for supervisors and enumerators at the Headquarter (Addis) and some provincial towns, it is always a must to provide **them** with instruction manuals.

The manual outlines; duties of field supervisors, duties of enumerators, organization of the crop production survey, selection of samples, completing interview questionnaire form CP-1, field area measurement, drawing of the field measured and crop-cutting experiment; a table of random numbers is attached as an Annex.

Complete set of the questionnaire, forms instruction manual used for this survey are available in the Documentation Section of PPD. However CP-I and CP-MS are attached in the Annex.

1.6 Personnel and Equipment

Personnel

The Statistical Working Group (SWG) which was appointed by the Head of Planning and Programming Department as pointed out earlier, put together all essential aspects of the survey.

To facilitate the conduction of the survey and to attain the result expected thirteen of the fourteen administrative regions were divided into the following six survey regions:

1. Northern region (Tigre, Wello)
2. North-Western region (Begemider Gojjam)
3. Central-Western region (Shoa, Wellega)
4. Southern region (Gemu Gofa, Sidamo, Bale)
5. South-Western region (Illubabor, Keffa)
6. Eastern region (Arussi, Hararghe)

One regional supervisor was assigned for each survey region. Twenty four field supervisors were appointed directly under the regional supervisors. From three to seven field supervisors were appointed for each survey region. Under the authority of the field supervisors field-teams were deployed. Each field supervisor had from one to five field teams within his assigned sample weredas, out of the twenty four total number of field supervisors eight were PPD employees, eleven were from EPID MPP areas and five were from CSO.

Sixty-one, two-men teams were mobilized throughout the selected weredas in the country. The number of selected administrative sub-divisions under any of the teams vary throughout the country, however, each team was responsible from two to eight selected administrative sub-divisions within the sample wereda.

Out of the total number of one hundred twenty two enumerators thirteen were permanent PPD/MOAF employees posted at the Headquarters in Addis Ababa or in branch offices of some of the administrative regions. The remaining one hundred and nine enumerators were temporary employees recruited from Addis Ababa and other respective regions.

There were a total of fourteen drivers assigned all over the sample weredas, of these six were permanent employees of MOAF and five were seconded from CSO to assist upto the end of the survey. Two additional temporary drivers were also hired.

Moreover quite a number of casual labourers were hired by supervisors and field teams to assist them in translation, guidance and guarding of camps.

Equipment

The availability of adequate equipment contributes a lot to the success of such survey. A team supplied with insufficient equipment and logistics can perform a poor job which could jeopardize the result of the survey.

These prevailed an acute shortage of equipment and other survey facilities this year. Most of the deficiency in the necessary equipment existed in the PPD/MOAF. However, with whatever assistance and cooperation was possible from CSO, the field-teams undertook the survey by combining the supplies and other resources available in both PPD and CSO.

The Statistical Working Group identified four types of equipment essential for conducting the survey.

These equipment include vehicles, tools and other supplies, field equipment and survey. The first two equipment are transportation facilities which include cars, spare-tyres, jerrycans etc. The field equipment are mainly tents, sleeping bags and instruments necessary for the actual fieldwork, some of the items are compasses, tapes, protractors, hand scales etc.

The SWG after selecting up the sample wereda, identified those weredas which were accessible for vehicles, for the inaccessible weredas, the field teams were instructed to use horses and mules which are usually rented in rural Ethiopia. At the outset the SWG assumed that each field supervisor, regional supervisor and the FAO statistician were to be served by a vehicle. On this basis it was estimated that a minimum of 33 four-wheel-drive vehicles were required. However, PPD/MOAF had 13 vehicles at its disposal, CSO supplied five vehicles and UNDP provided one vehicle. A total of 19 four-wheel drive vehicles were available or only 58% of the required vehicles were despatched to serve in the crop sample survey of 1975/76.

These 19 vehicles were distributed by administrative regions with the exception of Begemider, Arussi and Keffa which were served by 2 vehicles each, the other administrative regions had one vehicles for each. Exceptional administrative regions were Bale and Wello which had no vehicles supplied, but were served by vehicles from the Headquarters or from the nearby administrative regions. The 19 vehicles dispatched were supplemented by vehicles from EPID and Regional Agricultural officers. EPID provided supervisors and vehicles for the field teams assigned at the vicinity of its minimum package areas (MPP).

The details for survey equipment, field equipments and tools and other supplies is indicated in the tables below.

Required and available field and survey equipments

I t e m	Required	Available			
		PPD	CSO	UNDP	Total
I Vehicles					
a) Cars	33	13	5	1	19
b) Jerrycans	66	30	8	-	38
c) Spare-tyres	33	13	5	1	19
II Survey Equipment					
a) Compass	91	11	13	19	43
b) Protractor	91	35	-	-	35
c) Handscale	91	40	-	-	40
d) Chain	61	50	-	-	50
e) Pole	450	450	-	-	450
f) String	183	183	-	-	183
g) Ruler	91	80	-	-	80
h) Clipboard	91	2	-	-	2
III Field Equipment					
a) Sleeping bag	152	30	10	-	40
b) Tents	91	9	5	-	14
c) Mattresses	152	61	-	-	64
d) Cooking Sets	91	61	-	-	64
IV. Calculating Machine	10	8	-	-	8

1.7 Training of Supervisors and Enumerators

The training course for all supervisors and for enumerators of Wellega, Shoa and partly for Keffa, Wello and Tigre was conducted in Addis Ababa by the FAO Statistician and other members of SWG. The course lasted one week and covered all phases of the survey operations namely selection of samples, collection of data on holding and carrying out field measurement and crop-cutting experiment. The training consisted mainly of two parts, class-room training and field training. In the classroom, the lecture dealt with the importance of the survey, the responsibility of supervisors and the techniques of supervision. The field training dealt with the practical aspects of field measurement and crop-cutting experiment. The details of the training programme is attached in the Annex four.

Fifty four enumerators were recruited at the Headquarters (others were recruited and given the necessary training by field supervisors with the help of regional supervisors in their respective regions). The training and recruitment lasted from three to eight days.

After the training programme was completed, evaluation test was given both to field supervisors and enumerators. The purpose of the evaluation test was to find out the effectiveness of the training programme. Moreover, all the necessary adjustment and retraining programme was done to improve the quality of the supervision as well as the data.

1.8 Progress of Field Work and Supervision

The country was divided into six regions. From 7 to 15 teams depending on the place of one field supervisor was provided with a vehicle and a driver. Their duty was to watch the progress of the field work, check enumerators' work, rectify the mistakes made, etc.

The field work of the crop production survey started during the first week of November and was completed by the middle of February.

In addition to general checking of the field work and scrutinizing the forms completed by the time of their visit, the supervisors were also required to carry out actual spot-checking of:

- (a) listing of holders in selected administrative sub-divisions from which 10% of holders were randomly selected.
- (b) all information collected and recorded by the enumerators in accordance with the randomly selected holders in the sample within a wereda.

The mistakes in the listing of holders had to be corrected before selection of holders for the survey. The supervisor had to record his findings and the information recorded by the enumerator with respect to all survey items for the holders selected for his spot-check. The purpose of this rationalized spot-check was to have an objective assessment of the nature and extent of mistakes committed by the enumerators.

The field work was also inspected at every stage of its progress by the FAO statistician who visited six out of thirteen provinces during the field work of

the survey. His supervision was mainly aimed at ensuring that the supervisors carried out their duties properly and solving the technical difficulties that might arise. He was also collected information concerning frame for conducting an agricultural census which might be carried out in 1978.

1.9 Editing and Processing of the Data

Prior to forwarding the questionnaires to the Headquarters, the field supervisors had to check for omissions, inconsistency when recording and other errors due to illegible writing on the spot.

During the field editing the supervisors scrutinized to eliminate errors in the completed questionnaires and forms and later, if errors were discovered at this stage, the enumerators were instructed not to repeat such errors and how to correct them. The obvious errors were corrected at this stage without making a reference to the respondent.

Special team of fourteen persons was set up for editing, processing and checking the data in the headquarters. Their main job was to check whether all answers to questions were obtained. The scrutiny of the questionnaires and forms helped us to minimize the errors made at the time of enumeration considerably. The checking of area measurement and conversion of local units into standard units took most of the editing time.

The data was processed by hand. The processing was divided into three stages:

Stage I - the data were transferred from the questionnaires and forms to a special working sheet.

Stage II - appropriate data prepared for each wereda in the forms of working tables.

Stage III - Final tables were prepared for each regions and for the whole country. All stages of the data processing was checked by special team of 3 persons. All operations of the data processing took 6 weeks.

1.10 Preparation of the Report

It is very important to publish any report on time. This is especially more emphasized with publications of statistical nature. The information should be up to date and timely.

To facilitate and meet this demand, the Economics and Statistics Division has established a report writing group.

At the initial stage, the group discussed on the contents and format of the report. Later, specific topics were allocated to each member of the group. Moreover, the group met regularly to discuss on the topics prepared by each member and made the necessary comments and corrections.

Some parts of the report were even started before the processing of the data.

The members of the report writing group are:

Dr. Jan Kordos, FAO Agricultural Statistics Adviser
Ato Dereje Asrat, Central Statistical Office
Ato Mersi Yehun, Planning and Programming Dpt.
Ato Ghebre Selassie Mebrahtu, Planning & Programming
Dpt.

Chapter II

SELECTION OF SAMPLES AND ESTIMATION METHODS

2.1 Introduction

Yield, production, and area under crops are estimated using sampling method - a scientific approach in which randomly selected agricultural holdings and fields are studied. In as much as possible, the principal objective of any sampling procedure is to select sample holdings that are representative of all holdings in the country and be able to make statistically valid conclusions on the basis of the sample. Sampling involves minimum cost, labour and time; moreover, it leads to a higher overall level of accuracy. It has some disadvantages too. Apart from being subject to sampling error, it does not permit all the cross-classification required.

In order to arrive at a satisfactory conclusion using sampling method, there are a number of basic principles to be kept in mind. First of all, complete and up-to-date sampling frames must be established from which a sample of holdings and fields can be selected. Secondly, the sample size, i.e. the number of selected holdings and fields must be adequate enough to give a reliable estimate. Thirdly, every agricultural holding in the country should have a chance of being selected in the sample; and this chance should be known. It should also be possible to estimate the reliability of the estimates from the sample data themselves.

There are three elements in the process of sample survey: selection of the sample, collecting the information, and making an inference about the population.

The three elements are all interwoven and each has an impact on the others.

This chapter describes the most important elements connected with sampling design used in the crop production survey.

2.2 Sampling Frames

To select samples of holdings and fields under different crops for crop production survey we needed lists of holdings and fields in the country. Such lists are called a sampling frame. Since sampling frame is very important for the sample selection the composition of the sample is directly based on these lists.

There were no adequate frames readily available for agricultural surveys in Ethiopia during the preparation of this survey. Suitable frame would become available after conducting population census which is planned to be carried out in January 1977. Until that time one may use available lists of administrative units (such as wereda, administrative sub-division or Farmers' Association) for sampling purpose or prepare special frame. But the construction of a frame suitable for crop production survey may well constitute a major part of the work of the survey.

Under these limitation, we decided to use list of weredas (Ethiopia is divided into about 570 weredas, out of which 452 are agriculturally important), lists of administrative sub-divisions or Farmers' Association (where there was no complete list of Farmers' Associations in selected wereda list of administrative sub-divisions were used as frame) we had to prepare special

lists of holdings for selection purposes. Lists of fields under different crops were prepared on the basis of selected holdings in administrative sub-division.

List of weredas was up-to-dated and consisted of all agriculturally important weredas in the nation (out of 452 agriculturally important weredas 57 weredas were dropped for security reasons, thus frame for selection constituted of 395 agriculturally important weredas). If the list of administrative sub-divisions was out date in selected weredas, list of Farmers' Associations was prepared.

2.3 Sample Sizes

Available financial resources and organization possibilities were the main factors which determined the sample sizes of holdings for interview and fields for area measurements and crop-cutting experiments.

Available resources limited us to collect required data from not more than 5,000 holdings, take about 4,000 fields for area measurements and conduct about 1000 crop-cutting experiments. Then we have to remember that as the size of the sample becomes too small, the random fluctuations increase so much that the data may be worthless. Obviously, this affects more the sub-groups of population (e.g. regions of the country) -- the individual cells of a cross-tabulation -- since these get only a fraction of the sample; if the sample in these sub-groups is too small, the tabulation will be of no value. For these reasons we confined cross-classification to minimum.

2.4 Selection of the Samples

To some extent existing sampling frame determined a choice of sample selection. For this survey only lists of weredas and administrative sub-divisions (or list of Farmers' Associations in wereda) were available.

To minimize the cost of the survey three stage sample design was applied:

- (i) at the first stage 45 weredas were selected with equal probability (30 weredas were selected for the agricultural sample survey* ([1]) last year, and 15 weredas were selected this year out of 395 weredas which were of agricultural importance and accessible for the survey . Weredas were ordered according to crop pattern and provinces before selection.
- (ii) at the second stage 10 per cent of administrative sub-divisions or Farmers' Associations were chosen with equal probability in weredas selected at the first stage;
- (iii) at the third stage 10 percent of holdings with crop-land were selected with equal probability in each administrative sub-division (or Farmers' Association) which was chosen at the second stage. Holdings were selected from special list prepared for this purpose by enumerators on which holdings with cropland were serially numbered and selected for the survey.

*) 30 weredas were retained from last year to increase efficiency of dynamic analysis. However, it was possible to repeat the survey only in a few weredas since new organization started and Farmers' Association were selected as secondary sampling units.

Selected holders were interviewed by enumerators on area of different fields under crops and expected production. The enumerators next prepared lists of fields, separately for each crop, from which sub-samples of fields were selected for area measurements and crop-cutting experiments. Fields were selected systematically with random starts as follows:

- (a) 25 per cent of fields in sample (every fourth field starting from randomly selected number from 1 to 4) for teff, barley and maize;
- (b) 33.3 per cent of fields in the sample (every third field starting from randomly selected number from 1 to 3) for wheat, sorghum and horse bean;
- (c) 50 per cent of fields in the sample (every other field starting from randomly selected number 1 to 2) for millet, field peas, chick peas, lentils, haricot beans, flax, neug, rape seed and sesame.

2.5 Method of Estimation

Since sampling method was applied to collect the crop production data then it enables us to draw conclusions about the whole population in the country, i.e. about all holdings with cropland in Ethiopia. We must decide, therefore, how to make estimates from the sample to population, and how to estimate the sampling errors of such estimates. Estimation procedure is not independent, but is guided by the manner in which the sample has been selected.

In this section we will deal with method of estimation of several parameters of the population from the numerical results obtained in the sample. These estimates are required not only for the whole population, but also for the different parts of it, e.g. for different regions of the country. The formulae of estimation here applicable to the whole population are in general applicable also to the part of it, and need not be discussed separately.

We are going to estimate mainly totals, averages and ratios of different characteristics using the sample data. Formulae for these parameters are given below.

Total value of characteristic X in population

$$\hat{X} = \frac{N}{n} \sum_{i=1}^n \hat{H}_i \cdot \bar{x}_i \quad (1)$$

Where N stands for the number of weredas in the population from which the sample was selected (452);

n - number of selected weredas in the sample (= 45);

H_i - total number of holdings in selected wereda i which is estimated as follows:

$$\hat{H}_i = \frac{S_i}{s_i} \sum_{j=1}^{s_i} H_{ij} \quad ?$$

$S_i \rightarrow \text{pop (FH) To}$
 $s_i = \text{pop (FH) in}$

(2)

in wereda
i = FH

where S_i stands for the total number of administrative sub-divisions or Farmers' Associations in wereda i ,

s_i - number of selected administrative sub-divisions or Farmers' Associations in wereda i ,

H_{ij} - total number of holdings with cropland in selected administrative sub-division or Farmers' Association j in wereda i (list of total number of holdings in selected administrative sub-division or Farmers' Association was prepared for holdings' selection).

Average value of characteristic X per holding estimated from sample data in selected wereda i , i.e. \bar{x}_i which is given in formula (1), is calculated as follows:

$$\bar{x}_i = \frac{\sum_{j=1}^{s_i} \sum_{k=1}^{h_{ij}} x_{ijk}}{\sum_{j=1}^{s_i} h_{ij}} \quad (3)$$

where x_{ijk} stands for the value of characteristic X in selected holding k belonging to administrative sub-division j and wereda i ,

h_{ij} - number of holdings selected in administrative sub-division j and wereda i .

According to formula (1) we will estimate total area under crop in question, total crop production,

1
1

total area of cropland, fallow land, other land and total area of holdings (data collected according to farmers' reporting).

We can also estimate using formula (1) total number of holdings in population if we put for $x_{ijk}=1$, then

$$\hat{H} = \frac{N}{n} \sum_{i=1}^n \hat{H}_i \quad (4)$$

Average value of characteristic X per holding in population

We will get average value of characteristic X per holding if we divide formula (1) by formula(4), i.e.

$$\bar{x} = \frac{\sum_{i=1}^n \hat{H}_i \bar{x}_i}{\sum_{i=1}^n \hat{H}_i} \quad (5)$$

Using formula (5) we will estimate average area under crop per holding, average of total area per holding and so on.

Ratio of two quantitative variates in population

If we want to estimate ratio of two characteristics, e.g. X and Y, then first we should estimate the totals of the two characteristics for the population by formula (1) and take ratio of these totals:

$$\hat{R} = \frac{\hat{X}}{\hat{Y}} = \frac{\sum_{i=1}^n \hat{H}_i \bar{x}_i}{\sum_{i=1}^n \hat{H}_i \bar{y}_i} \quad (6)$$

where \bar{x}_i and \bar{y}_i are calculated according to formula(3).

Using formula (6) we will estimate average yield of different crops, here X will stand for crop production, and Y for area under crop.

The formulæ given above can be applied to estimate different parameters of the population using the data collected from farmers during the survey, i.e. according to farmers' reporting. The main objective of this survey is to estimate crop production for major crops and area under these crops. The total crop production can be regarded as the product of its area (i.e. area under crop) and the mean yield per hectare. These two quantities may, therefore, be estimated separately. It is well known that crop production data according to farmers' reporting are usually underestimated. For this reason we applied objective methods of area measurement and crop-cutting experiments to estimate area and yield respectively. We combined both data, i.e. data collected from farmers and obtained from field area measure-

ments and crop-cutting experiments to estimate area under crop and yield.

Estimation of area under crop

As mentioned above, area under crop estimated according to farmers' reporting is usually underestimated. To correct the area under crop estimated by farmers, a sub-sample of fields was selected out of all fields under crop in question and these fields were measured by special teams.

Total area under crop according to farmers' reporting is calculated by formula (1) as follows:

$$\hat{A} = \frac{N}{n} \sum_{i=1}^n \hat{H}_i \bar{a}_i \quad (7)$$

where \bar{a}_i is average area under crop per holding calculated according to formula (3) from the sample data in wereda i.

A sub-sample of fields under crop in question in each wereda was selected, and after field area measurements the following ration was calculated:

$$c_i(a) = \frac{\sum_{f=1}^{g_i} a_{if}^{(m)}}{\sum_{f=1}^{g_i} a_{if}} \quad (8)$$

W

where g_i stands for the number of fields selected for area measurements for crop in question in wereda i,

$a_{if}(m)$ - area of the field f under crop in question estimated according to area measurement in wereda i,

a_{if} - area of the field f under crop in question estimated according to farmers' reporting in wereda i.

Taking into account formulae (7) and (8) we give corrected formula for estimating area under crop as follows:

$$\hat{A}(m) = \frac{N}{n} \sum_{i=1}^n \hat{H}_i \bar{a}_i c_i(a) \quad (9)$$

where \bar{a}_i and $c_i(m)$ are calculated according to formulae (3) and (8) respectively.

Estimation of average crop yield

Average crop yield is first estimated according to farmers' reporting by formula (6):

$$\bar{y} = \frac{\sum_{i=1}^n \hat{H}_i \bar{q}_i}{\sum_{i=1}^n \hat{H}_i \bar{a}_i} \quad (10)$$

where \bar{q}_i stands for average crop production per holding in selected wereda i, and calculated by formula (3),

\bar{a}_i as above.

Average crop yield calculated according to formula (10) is usually underestimated. To estimate average yield correctly, using objective method, a sub-sample of fields under crop in question was selected and crop-cutting experiments were conducted. On each selected field two plots (16 m² each) were randomly chosen, harvested and threshed. Average yield according to crop-cutting experiments for crop in question was calculated by following formula:

$$\bar{y}_c = \frac{\sum_{t=1}^m (w_{1t} + w_{2t})}{32 \times m} \times 10 \text{ Kgs/ha} \quad (11)$$

where m stands for the number of fields under crop in question on which crop-cutting experiments were conducted,

w_{1t} - weight of grain (in grams) obtained from the first plot in the field t after two weeks of drying,

w_{2t} - weight of grain (in grams) obtained from the second plot in the field t after two weeks of drying.

32 is sum of square meters on the two plots selected in the field (area of each plot is equal to 16 m²).

using the same fields on which crop-cutting experiments were conducted we may estimate average yield according to farmers' reporting:

$$\bar{y} = \frac{\sum_{t=1}^m q_t}{\sum_{t=1}^m a_t} \frac{\text{Kgs}}{\text{ha}} \quad (12)$$

where q_t stands for crop production from field t according to farmers' reporting (in kilograms),

a_t - area of selected field t and estimated according to farmers' reporting (in hectares).

To find out to what extent yield according to farmers' reporting is underestimated (or overestimated) the following ratio is calculated:

$$c(y) = \frac{\bar{y}_c}{\bar{y}} \quad (13)$$

where \bar{y}_c and \bar{y} are calculated according to formula (11) and (12) respectively.

Corrected average crop yield is calculated as follows:

$$\bar{Y}_c = \bar{Y} \times c(y) \quad (14)$$

where \bar{Y} and $c(y)$ were calculated according to formula (10) and (13) respectively.

Estimation of total crop production

As mentioned above, the total crop production can be regarded as the product of its area and the mean yield per hectare. We estimated already both components, i.e. area by formula (9), and the mean yield per hectare by formula (14). Total production is, therefore, estimated as follows:

$$Q_c = A(m) \cdot \bar{Y}_c \quad (15)$$

where $A(m)$ was calculated according to formula (9) and \bar{Y}_c was estimated at regional level, but for the country as a whole was calculated as follows:

$$\bar{Y}_c = \frac{\sum_{i=1}^6 A_i(m) \cdot \bar{y}_i}{\sum_{i=1}^6 A_i(m)}$$

where $A_i(m)$ stands for area under crop in question in region i ($i = 1, 2, \dots, 6$);

\bar{y}_i - the mean yield according to farmers' reporting calculated by formula (10).

2.6 Estimation of Sampling Errors

We estimated several parameters of the population using sample data, but these estimates are subject to sampling and non-sampling errors. Non-sampling errors will be discussed in the last chapter of the report. Here we confine ourselves only to method of estimation of sampling errors and give general interpretation of these errors.

Size of sampling errors depends on such elements as sample design, method of estimation, sample size and variability of characteristics in question. As a rough approximation, it is true to say that sampling error depends on the sample size, not the sampling fraction.

The feature of sampling errors refers to the discrepancies between the sample estimates and the population values that would be obtained from enumerating all units in the population (e.g. all holdings in the country) in the same way in which the sample is enumerated. These discrepancies are unavoidable because sample estimates are based on data for only a sample of units. The employment of sampling method, however, enables estimates of the average magnitude of these discrepancies to be made. As a measure of these average discrepancies in sampling theory a standard error is accepted. The standard error gives an idea of the frequency with which errors (differences between the sample estimate and the population value) of a given magnitude may be expected to occur if repeated random samples of the same size are drawn from the population. Usually errors smaller than the standard error will occur with a frequency of about 68 per cent, provided the estimate is approximately normally distributed.

Since we applied a three-stage sample selection, then calculating the standard error will be a time consuming procedure. It is obvious that it involves a great amount of work, and much too expensive. At times the variance computations might cost much more than the tabulation of the survey data themselves. Therefore, in order to simplify calculations we used sub-samples method (interpenetrating samples).

According to this method we divide the sample into a number of sub-samples at random, and use each sub-sample to make estimates of the totals. Each one of the sub-samples will reflect the various steps of the sample selection so that the estimate from each sub-sample is an estimate of the total with the same sample design as the whole sample - except, of course, that the sample size is much smaller. In computing the standard error it is exactly the standard error between different estimates of the total in which we are interested.

All primary sampling units (weredas) were divided into 5 sub-sample randomly (each sub-sample consisted of 9 weredas). For each sub-sample characteristics in question, were calculated averages, i.e. $\bar{x}_1, \bar{x}_2, \bar{x}_3, \bar{x}_4$ and \bar{x}_5 , where \bar{x}_1 stands for estimate of the first sub-sample, \bar{x}_2 for the second, and so on. Next we calculated average for all sub-sample as follows:

$$\bar{x} = \frac{1}{5} \sum_{s=1}^5 \bar{x}_s \quad (16)$$

where \bar{x}_s stands for characteristic calculated for sub-sample s ($s = 1, 2, \dots, 5$).

Standard error is calculated from the following formula:

$$s(\bar{x}) = \sqrt{\frac{1}{20} \sum_{s=1}^5 (\bar{x}_s - \bar{x})^2} \quad (17)$$

We calculated also rel-standard error, i.e. coefficient of variation of standard error as follows:

$$v(\bar{x}) = \frac{s(\bar{x})}{\bar{x}} \quad (18)$$

Sampling errors for some of the most important characteristics calculated according to above method are given in the last chapter of **this report**.

Chapter III

AREA, YIELD AND PRODUCTION OF MAJOR CROPS

3.1 Introduction

Area, yield and production of major crops consisting of teff, barley wheat, maize, sorghum, millet, horse beans, haricot beans, chick peas, field peas, lentils, flax, neug and sesame, were estimated according to farmers' reporting, field area measurements, and crop-cutting experiments.

The survey was confined to private peasant holdings in the agriculturally important areas of Ethiopia, excluding nomadic areas, state farms and co-operative farms.

Information on areas under major crops were collected as mentioned above, by interviewing the holders. It is well known that areas reported by holders are usually underestimated, and should be corrected. To correct area of major crops reported by holders, a sub-sample of fields under major crops was selected and measured.

Yields of major crops, calculated as ratio of production and area reported by holders, are also underestimated. Crop-cutting experiments were carried out for a sub-sample of fields to correct yields calculated according to farmers' reporting.

Having corrected area under major crops and corrected yields, crop production estimates were obtained as the products of area and yield.

The data concerning area, yield and production of major crops generalized for the whole private holdings in the agriculturally important areas of Ethiopia are

presented in this chapter; however, appropriate data by regions are given in the annex.

3.2 Number and Area of Holdings

The total number of holdings with cropland in the agriculturally important weredas is estimated (applying formula (4) in chapter II), at 5.1 million which occupy, according to farmers' reporting, 6.0 million hectares (this includes fallow land and other land within the holding in addition to cropland). Thus the average area of holding is 1.16 hectares. Cropland reported by holders, as shown by area measurement, is underestimated approximately by 28% (see section on "Field area measurement results" of this chapter). Thus, it was possible to correct area of total holdings which, after this correction, is estimated at 7.7 million hectares, and the corrected average area per holding is 1.49 hectares.

These estimates are subject to sampling errors since they were estimated on sampling basis. The sample consisted of 4,452 holdings, 3,463 field area measurements, and 871 crop-cutting experiments. Analysis of the precision of these estimates, and others, are given in chapter VI (Analysis of sampling errors).

3.3 Area, Production and Yield of Major Crops Reported By Farmers:

Data on area under major crops and expected production were collected by interviewing the holders. Area and production were given in local units and converted into hectares and quintals respectively in the field by enumerators (see [4]).

The data collected from the sample of 4,452 holdings were generalized for all holdings, i.e. 5,129.8 thousand in the agriculturally important weredas of Ethiopia.

Areas under major crops were estimated using formula (7), while total production by formula (1) as given in chapter II.

Average crop yield was calculated by formula (10) as the ratio of crop production and area under crop in question.

According to farmers' reporting, it is estimated that 1,353.2 thousand hectares were under teff, 604.6 thousand hectares under maize, 585.8 thousand hectares under sorghum, 507.3 thousand hectares under barley, 335.3 thousand hectares under wheat, and so on.

Details of the estimates of area, production and yield of major crops reported by farmers are given in table 1.

The data presented in this table are underestimated and must not be used directly. However, it is possible to correct them using objective methods.

3.4 Field Area Measurement Results

It is well known from international practice that area under different crops reported by farmers during interview is usually underestimated. To correct this area, it is necessary to measure a sub-sample of fields under different crops. Eventhough this method is more expensive than interview method, it is necessary if one wants to obtain more accurate data.

Table 1

ESTIMATES OF AREA, PRODUCTION AND YIELD OF MAJOR CROPS ACCORDING TO FARMERS' REPORTING

Crop	Area	Production	Yield
	Thousand hectares	Thousand quintals	Quintals per ha.
(1)	(2)	(3)	(4)
Teff	1,353.2	6,455.5	4.8
Barley	507.3	2,567.2	5.1
Wheat	335.3	2,190.7	6.5
Maize	604.6	4,138.3	6.8
Sorghum	585.8	4,541.5	7.8
Millet	272.0	1,091.2	4.0
Horse beans	164.3	1,082.8	6.6
Chick peas	124.8	431.6	3.5
Haricot beans	27.7	132.7	4.8
Field peas	80.7	264.3	3.3
Lentils	44.6	162.6	3.6
Flax	69.2	200.7	2.9
Neug	181.9	288.5	1.6
Sesame	11.1	20.2	1.8
Others	19.8	84.8	4.3
<u>Total Cropland</u>	<u>4,382.3</u>	<u>23,652.6</u>	<u>5.4</u>

In this survey it was expected that about 4,360 fields would be measured for major crops, but only 79.5% of the selected fields (3,463 fields) were accepted. In 6.6% of selected fields farmers refused to allow measurement and over 4.3% of fields were measured not correctly and were rejected during editing. Some failure in the field measurements were connected with the lack of equipment (compasses, chains) and inadequate supervision.

The results of field measurement are given in table 2. Column 2 shows the number of field measured and accepted. In column 3 averages of area in hectares per field obtained during field measurements are given. In column 4 averages of area reported by farmers for the same fields which were measured and presented. In column 5 area correction coefficients which were calculated as quotients of column 2 and column 3 are given. Area measurement results by region are given in the annex.

The area of total cropland is underestimated approximately by 28%. Area correction coefficients for major crops show that the smallest underestimation of area were for sesame (0.4%), millet (14%), flax (15%) and barley (16%); whereas for wheat, horse beans, chick peas, and other crops the underestimation ranges from 18% to 80%. Such cases justify that area correction are necessary.

3.5 Corrected Area Under Major Crops

Having area under major crops according to farmers' reporting and correction coefficients for these areas, we can obtain corrected area under major crops. Corrected area for each crop was estimated as a product of the area reported by farmers under this crop and area correction coefficient for the same crop at the wereda level.

Table 2

FIELD AREA MEASUREMENT RESULTS

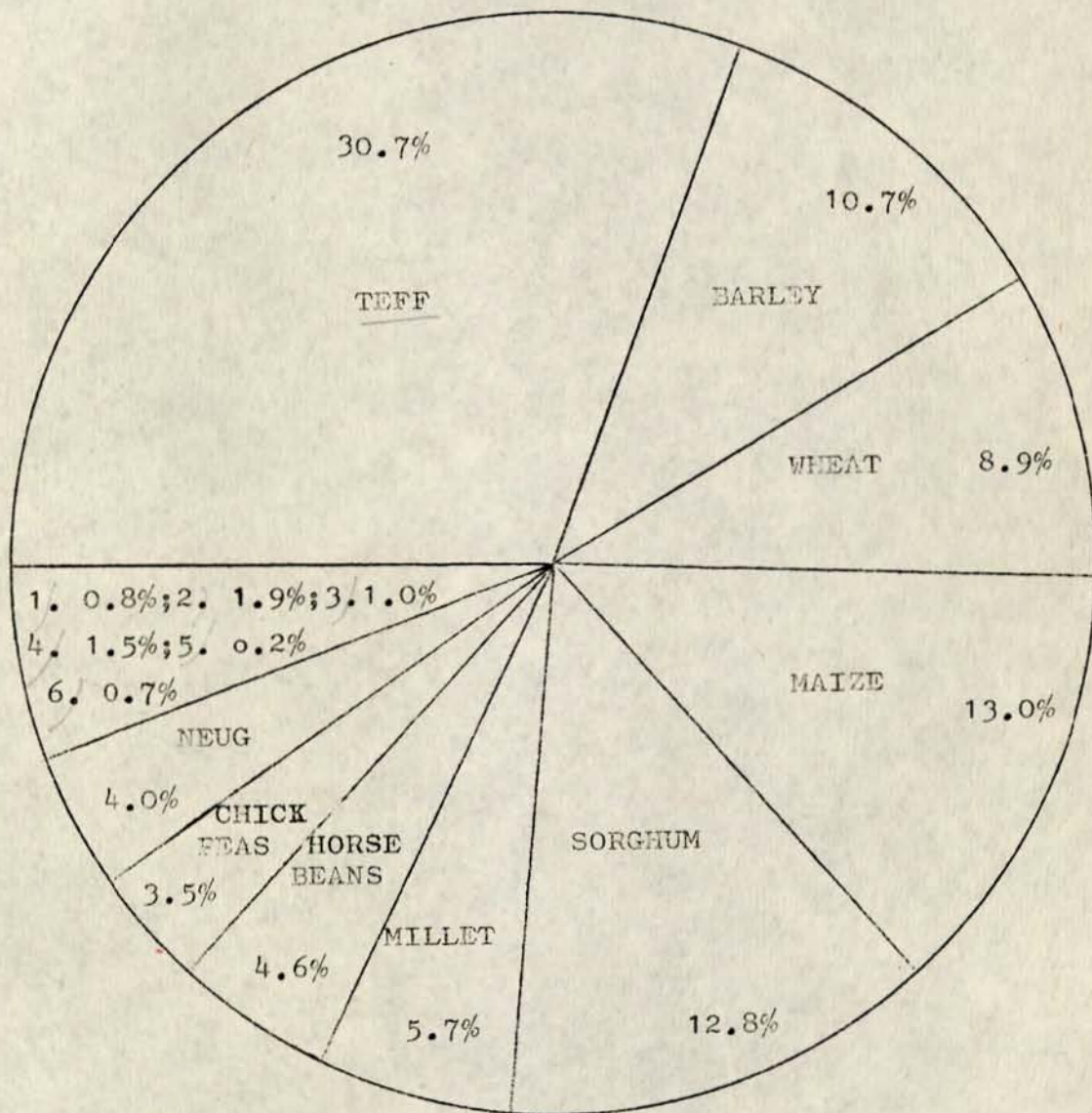
Crop	Number of field measurements	Average are per field according to		Area correction coefficient
		measu- ment in hectares	farmers report	
(1)	(2)	(3)	(4)	(5)
Teff	759	0.360	0.286	1,259
Barley	278	0.339	0.292	1,161
Wheat	277	0.463	0.310	1,494
Maize	498	0.289	0.242	1,195
Sorghum	506	0.309	0.261	1,184
Millet	288	0.312	0.274	1,139
Horse beans	203	0.362	0.232	1,560
Chick peas	133	0.475	0.263	1,806
Haricot beans	90	0.186	0.133	1,398
Field peas	119	0.279	0.215	1,298
Lentils	72	0.322	0.249	1,293
Flax	64	0.353	0.307	1,150
Neug	150	0.486	0.392	1,240
Sesame	3	2.390	2.380	1,004
Others	23	0.234	0.145	1,614
<u>Total Cropland</u>	<u>3463</u>	<u>X</u>	<u>X</u>	<u>1,279</u>

Table 3

CORRECTED AREA UNDER MAJOR CROPS

Crop	Corrected area	
	Thousand hectares	Per cent [†]
(1)	(2)	(3)
Teff	1,720.6	30.7
Barley	600.9	10.7
Wheat	500.0	8.9
Maize	727.6	13.0
Sorghum	718.3	12.8
Millet	310.5	5.7
Horse beans	258.7	4.5
Chick peas	197.5	3.5
Haricot beans	42.2	0.8
Field peas	107.3	1.9
Lentils	56.2	1.0
Flax	82.2	1.5
Neug	226.3	4.0
Sesame	11.1	0.2
Others	40.6	0.7
<u>Total Cropland</u>	<u>5,606.0</u>	<u>100.0</u>

Fig. 1. PERCENTAGES OF AREA UNDER MAJOR CROPS



- | | |
|-------------------|------------|
| 1. Haricot beans. | 4. Flax. |
| 2. Field peas. | 5. Sesame. |
| 3. Lentils. | 6. Others. |

3.5 According to the above correction, it is estimated that 1,720.6 thousand hectares (30.7% of total area of cropland) are under teff, 727.6 thousand hectares (13.0%) are under maize 718.3 thousand hectares (12.8% are under sorghum. The details of the corrected area under different crops are given in table 3. As can be seen from table 3, teff, barley maize and sorghum account for about 67% of total area under major crops. The corrected area for major crops given in this table area mainly used for crop production estimates.

3.6 Crop-Cutting Experiment Results

Crop-cutting experiments were carried out to correct yield of major crops calculated from production data and area reported by farmers. It was expected to conduct crop-cutting experiments on not more than 1,000 fields hoping to use every fourth field selected for area measurements (out of 4,000 fields). Moreover, since the survey started in November instead of September, then it was decided to carry out crop-cutting experiments on all fields selected for area measurements in order to get sufficient number of fields. As a result of this approach, crop-cutting experiments conducted on 917 fields, out of which 871 crop-cutting experiments were accepted as correctly done (46 crop-cutting experiments were rejected during editing). Two plots were randomly selected from each field (16 m^2 each: 4m x 4m) which brings the total number of plots to 1,742. The harvested plants from each plot were threshed by hand and the grain were weighed. The threshed grains from each plot were stored into small bags separately for two weeks. After two weeks of drying the grains were weighed again to determine the actual yield for calculation purposes.

Average yield for each crop in question was calculated by formula (11) as given in chapter II. Using the same fields on which crop-cutting experiments were conducted, average yield according to farmers' reporting was calculated by formula (12). Yield correction coefficient which is the ratio of yield from crop-cutting experiments and yield from farmers' reporting was calculated by formula (13).

The results of the crop-cutting experiments are given in table 4. Since the sample size was too small to infer for regions, the inference is done for the country as a whole. The number of fields on which crop-cutting experiments were conducted are given in column 2 of table 4; in column 3 - average yield according to crop-cutting experiments; in column 4 - average yield according to farmers' reporting; and in column 5 - yield correction coefficients are given.

Table 4 shows that the average yield of all major crops from crop-cutting experiments is higher than the yield calculated from farmers' reporting. Yield correction coefficients range from 1.16 for flax and field peas to 2.39 for maize, but these changes might be subject to sampling errors (size of samples for crop-cutting experiments are varying from 2 for field peas to 240 for teff).

3.7 Corrected Yield of Major Crops

Having calculated yield according to farmers' reporting and yield correction coefficient from crop-cutting experiments, we may calculate corrected yield by formula (14) as given in chapter II. For example,

Table 4

RESULTS OF CROP-CUTTING EXPERIMENTS

Crop	Number of fields	Average yield according to		Yield correction coefficient
		crop-cut- in exp.	farmers' reporting	
(1)	(2)	Kgs/ha		(5)
(1)	(2)	(3)	(4)	(5)
Teff	240	644	447	1.44
Barley	43	720	393	1.84
Wheat	97	914	611	1.50
Maize	57	1,587	664	2.39
Sorghum	205	1,224	857	1.43
Millet	87	1,009	437	2.31
Horse beans	16	779	472	1.65
Chick peas	34	744	503	1.48
Haricot beans	9	403	282	1.43
Field peas	2	687	595	1.16
Lentils	23	608	303	2.01
Flax	4	563	488	1.16
Neug	49	318	150	2.12
Sesame	-	-	-	-
Others	5	557	389	1.44
<u>Total Cropland</u>	871	X	X	1.74

for teff yield according to farmers' reporting is 4.77 quintals per hectare, and yield correction coefficient for the same crop is 1.44, then corrected yield for teff is equal to the product of field reported by farmers and yield correction coefficient, i.e.

$$4.77 \text{ qt/ha} \times 1.44 = 6.87 \text{ qt/ha.}$$

Corrected yields of major crops are given in table 5 . Moreover, the following additional components are given in table 5: in column 2 - yield correction coefficients, in column 3 - yield according to farmers' reporting and in column 4 - corrected yield which is the product of column 2 and column 3 .

Yield according to farmers reporting in column 3 was calculated as follows:

$$\bar{Y} = \frac{\sum_{i=1}^6 A_i(m) \times \bar{y}_i}{\sum_{i=1}^6 A_i(m)}$$

where A_i/m stands for corrected area under crop in question in region i / $i=1, 2, \dots, 6$ /;

\bar{y}_i - yield according to farmers' reporting in region i (calculated by formula /10/).

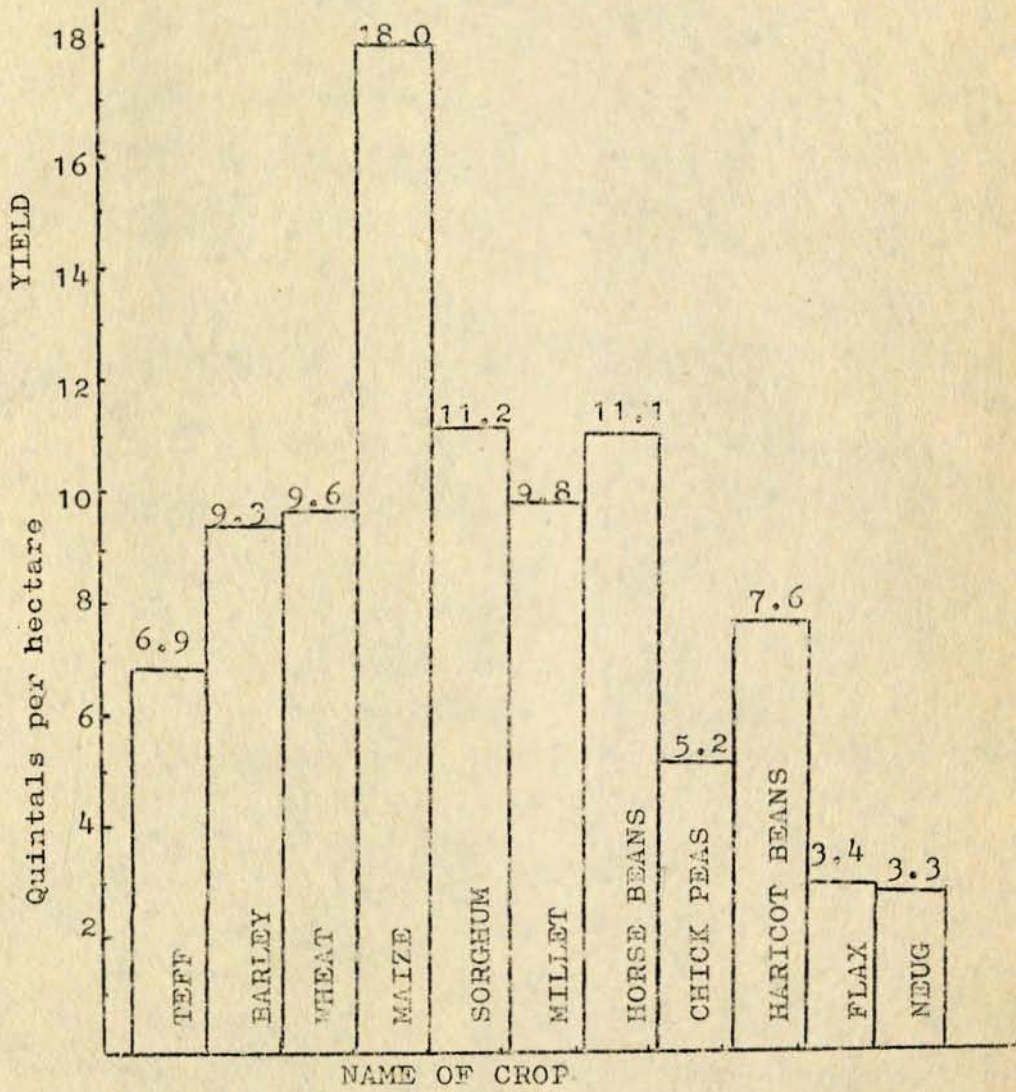
Therefore, the corrected yields given in column 4 are the final estimates of yields of major crops grown in the agriculturally important weredas.

Table 5

CORRECTED YIELD FOR MAJOR CROPS ACCORDING TO CROPS,
CUTTING EXPERIMENT RESULTS

Crop	Yield correction coefficient	Yield according to farmers reporting	Corrected yield
		Quintals/hectare	
(1)	(2)	(3)	(4)
Teff	1.44	4.77	6.87
Barley	1.84	5.04	9.27
Wheat	1.50	6.43	9.64
Maize	2.39	7.54	18.01
Sorghum	1.43	7.83	11.19
Millet	2.31	4.26	9.83
Horse beans	1.65	6.72	11.08
Chick peas	1.48	3.49	5.17
Haricot beans	1.43	5.35	7.65
Field peas	1.16	3.22	3.73
Lentils	2.01	3.77	7.57
Flax	1.16	2.92	3.39
Neug	2.12	1.57	3.33
Sesame	1.44	1.82	2.62
Others	1.44	4.36	6.28

Fig. 2. Yields for selected crops



3.8 Estimates of Corrected Area, Yield and Production of Major Crops

As mentioned in chapter II ("Method of estimation") the total production can be regarded as the product of area under crop in question and the mean yield. Both components : corrected area of major crops (table 3), and corrected yield (table 5) are already estimated. Therefore, total production is estimated by formula (15) as given in chapter II. As mentioned earlier, we have divided the country into six regions. To estimate the total production of crops for the whole country, we estimate the total production for each region and summed up through the productions of the six regions.

The estimate of the total area of cropland is 5.6 million hectares, out of which 1.7 million hectares (30.7% of cropland) is under teff, 0.6 million hectares under barley (10.7%), 0.5 million hectares under wheat, 0.7 million hectares under maize (13.0%), 0.7 million hectares under sorghum.

The details of area under major crops, yield and total production of these crops are given in table 6.

Among the major crops surveyed, the highest yielder is maize (18.0 qt/ha), following by sorghum (11.2 qt/ha), horse beans (11.4 qt/ha), millet (9.8 qt/ha), wheat (9.6 qt/ha), and barley (9.3 qt/ha). The lowest yielders are : field peas, flax, neug and sesame which is about 3 qt/ha for each. The over all average yield of all major crops is 9.4 qt/ha.

Total production is the highest for maize amounting to 13.1 million quintals (abbr. mill. qts), followed by teff 11.8 mill. qts, sorghum 8.0 mill.qts, barley 5.6

Table 6

ESTIMATES OF CORRECTED AREA, YIELD AND PRODUCTION
FOR MAJOR CROPS

Crop	Corrected		
	area	yield	production
	Thousand hectares	Quintals per hectare	Thousand quintals
(1)	(2)	(3)	(4)
Teff	1,720.6	6.9	11,828.9
Barley	600.9	9.3	5,567.8
Wheat	500.0	9.6	4,821.7
Maize	727.6	18.0	13,106.1
Sorghum	718.3	11.2	8,034.2
Millet	316.5	9.8	3,112.2
Horse beans	258.7	11.1	2,865.7
Chick peas	127.5	5.2	1,020.8
Haricot beans	42.2	7.6	322.7
Field peas	107.3	3.7	400.4
Lentils	56.2	7.6	425.2
Flax	12.2	3.4	278.9
Neug	226.3	3.3	752.5
Sesame	11.1	2.6	29.1
Others	40.6	6.3	254.9
Total Cropland	5,606.0	9.4	52,821.1

mill.qts, wheat 4.8 mill.qts, millet 3.1 mill.qts, horse beans 2.9 mill.qts, chick peas 1.0mill.qts neug 0.8 mill.qts, Total production for all major crops is estimated to be 52.8 million quintals.

The data given in table 6 should be considered as the final estimates of area, yield and total production of major crops, for private peasant holdings in the agriculturally important areas in Ethiopia in 1975/76 (1968 E.C.).

Chapter IV

SIZE OF HOLDING, LAND UTILIZATION, FRAGMENTATION AND USE OF FERTILIZERS

4.1 Introduction

The data collected during the crop production survey enables us to estimate not only area, yield and production of major crops which were presented in pervious chapter, but also to estimate some characteristics which can help us analyse size of holdings, land utilization, fragmentation and use of fertilizers.

For this survey, the area under the holdings has been classified into three land-use catagories, namely (i) cropland (ii) fallow land and (iii) other land.

Cropland is defined as area under annual crops as mentioned in the previous chapter. Fallow land is defined as land which is known to have been once cultivated but was not sown or planted with any crop in the 1975/76 (1968 E.C.) agricultural crop year. Other land is defined as land not classified under any of the above land-use catagories, such as vegetable garden, land under permanent crops such as coffee, chat, fruit, etc.

Size of holding is determined by total area of holding, which is area under cropland, fallow land and other land. Seven area groups were adopted, to help us analysing the holdings by size of total area.

The results on the various aspects of the size of holdings, land utilization, fragmentation and use of fertilizers by region are given in the annex. Here we have confined ourselves to the presentation and analyse the data obtained from the sample and generalized for all holdings in the agriculturally important weredas in Ethiopia.

4.2 Distribution of Holdings by Size of Total Area

In chapter III all characteristics of the holdings are presented as averages or totals (i.e. area, yield and production of major crops). But for some analytical purposes it would be interesting to know what kind of holdings constitute the sample, how many holdings belong to different area groups, and values of the different characteristics in these groups. To perform such analysis each holding is classified into one of the following seven area groups according to total area of the holding:

- (1) under 0,10 hectares
- (2) 0.11 - 0.50 "
- (3) 0.51 - 1.00 "
- (4) 1.01 - 2.00 "
- (5) 2.01 - 5.00 "
- (6) 5.01 -10.00 "
- (7) 10.01 and above

According to the classification made above, it is estimated that 159.4 thousand holdings (3.1% of the total) fall into group 1; 1,744.5 thousand holdings (34.0%) into group 2; 1,211.7 thousand holdings (23.6%) into group 3; 1.138.3 thousand holdings into group 4; 790.1 thousand holdings (22.4%) into group 5; 82.9 thousand holdings (1.6%) into group 6; and 2.9 thousand holdings (0.1%) into last group.

The above classification was done according to total area reported by farmers, but it is well known that the total area collected during interview from farmers is usually underestimated, as shown in chapter III. The total area for each holding was corrected according to field area measurement results (see field area measurement results as given in Chapter III)

and all holdings in the sample were re-classified according to corrected total area. This procedure gives us corrected distribution of holdings by size of total area.

According to the adopted classification and the procedure mentioned above, it is estimated that 66.7 thousand holdings (1.3% of the total) fall under group 1; 1251.7 thousand holdings (24.4%) into group 2; 1359.4 thousand holdings (26.5%) into group 3; 1215.8 thousand holdings (23.7%) into group 4; 1031.1 thousand holdings (20.1%) into group 5; 194.9 thousand holdings (3.8%) into group 6; 10.2 thousand holdings (0.2%) into last group. Comparison of distribution of holdings by size of total area estimated according to farmers' reporting and corrected by field area measurement result are given in table 7 both in number and percentages.

4.3 Number and Area of Holdings by Size

It is estimated according to farmers reporting that in the country as a whole, 60.7 percent of the holdings have less than one hectare accounting for only 25.1 percent of the total area of the holdings. Medium-sized holdings ranging from 1 to 5 hectares comprise 37.8 percent of the total number of holding, and 67.0 percent of the area. Larger holdings of 5 hectares and above account for only 1.7 percent of the number of **holdings** and 7.9 percent of the area. The details are given in table 8 both for observed area as given by farmers and corrected area.

The data in table 8 may be illustrated graphically by a curve known as the Lorenz curve. The Lornez curve of concentration is particularly useful for the presentation of the distribution of holdings by number and area.

Table 7

DISTRIBUTION OF HOLDINGS BY SIZE OF TOTAL AREA ESTIMATED ACCORDING TO FARMERS'
REPORTING AND CORRECTED BY FIELD MEASUREMENT RESULTS

Holdings	Distri- bution	Holdings by size of total area (in hectares)							
		Under 0.10	0.11 -0.50	0.51 1.00	1.01 -2.00	2.01 -5.00	5.01 -10.00	10.01 & above	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		In thousand							
Number=	obs.	159.4	1744.5	1211.7	1138.3	790.1	82.9	2.9	5129.8
	corr.	66.7	1251.7	1359.4	1215.8	1031.1	194.9	10.2	5129.8
		per cent							
Per cent	obs.	3.1	34.0	23.6	22.2	15.4	1.6	0.1	100.0
	corr.	1.3	24.4	26.5	23.7	20.1	3.8	0.2	100.0

Tbale 8

PERCENTAGE DISTRIBUTIONS OF NUMBER AND AREA OF HOLDINGS BY SIZE OF TOTAL AREA ESTIMATED ACCORDING TO FARMERS' REPORTING AND CORRECTED BY AREA MEASUREMENT RESULTS

Distri- bution	Holdings	Holdings by size of total area (in hectares)						
		Under 0.10	0.11 -0.50	0.51 -1.00	1.01 -2.00	2.01 -5.00	5.01 -10.00	10.01 above
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Observed	Cumulative percent of total							
	number	3.1	37.1	60.7	82.9	98.5	99.9	100.0
Corrected	area	0.2	9.6	25.1	52.8	92.1	99.8	100.0
	number	1.3	25.7	52.2	75.9	96.0	99.8	100.0
	area	0.1	5.4	18.2	40.9	81.9	98.5	100.0

(see fig 3). From table 8 one may find Lorenz coefficient of area concentration by holdings. This coefficient is 0.46 both for observed and corrected distributions. It is also possible to estimate from the table 8 that 20 per cent of holdings from the lowest area groups cover 4.7 per cent of total area, and 20 per cent of holdings from the highest area groups account for 52.2% of total area. Which shows that 20% of holdings from the highest area groups cultivated 11 times more area than 20 per cent of holdings from the lowest area groups.

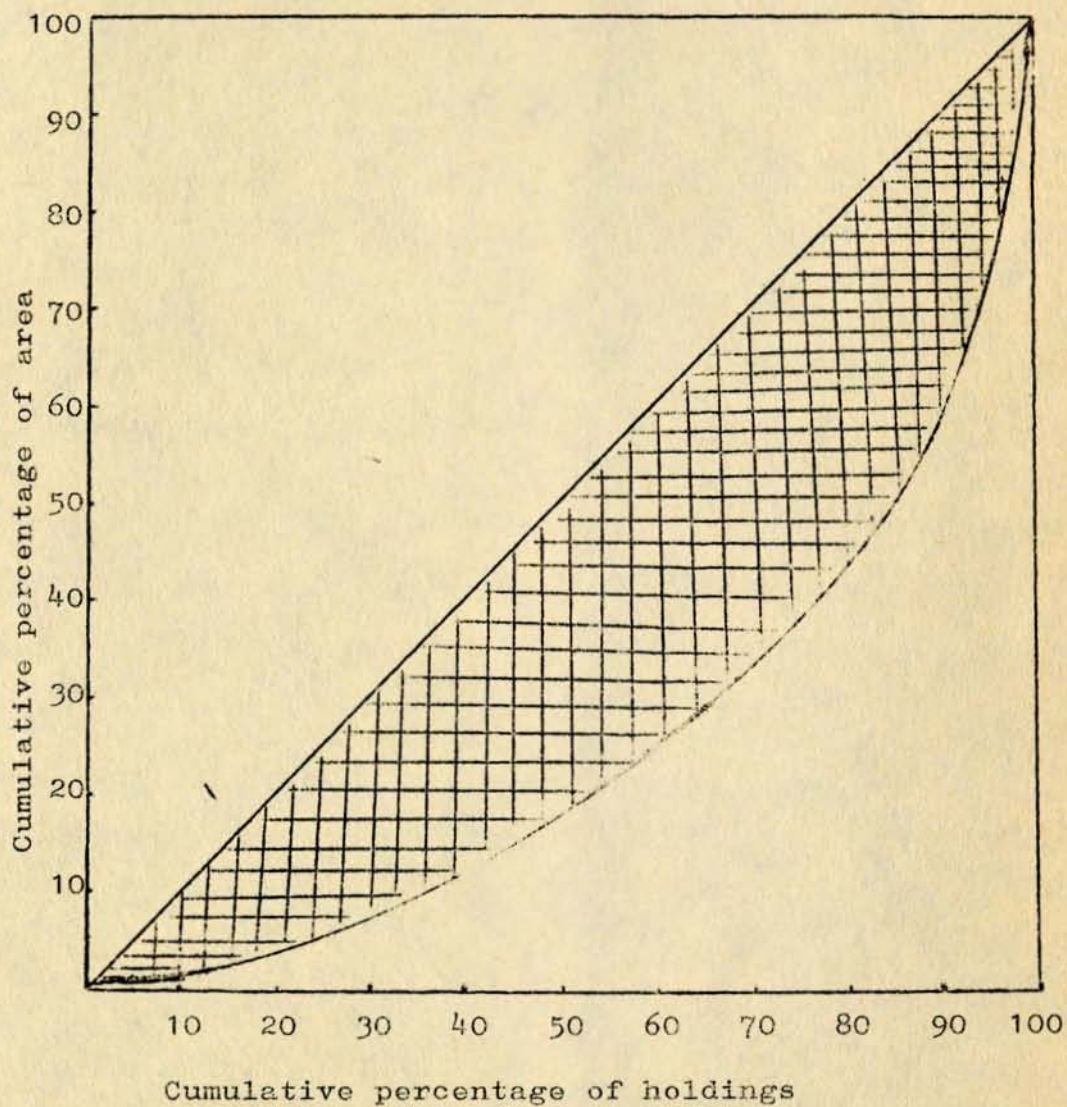
4.4 Number of Holdings Growing Different Crops and Area Under this Crops by Size of Total Area

The total number of holdings which grow crops in the agriculturally important weredas is estimated to be 5,129.8 thousand and the total area under these crops is 4,382.3 thousand hectares according to farmers reporting (or 5,606.0 thousand hectares when corrected).

According to our estimate teff is the most important crop grown under these holdings comprising 59.6% of the total number of holdings having reporting crops and, 30.9% of the total area under cropland. The second important crop is maize comprising 44.9% of the total number of holdings and 13.8% of area under crops. Sorghum ranks third according to the criteria made above comprising 34.5% of the total number of holdings and 13.4% of the total area under crops.

The distribution of the other important crops by total number of holdings reporting crops and area under these crops is given in table 9.

Fig. 3. The Lorenz curve of concentration



In table 9 only totals and percentages for all holdings, are given; however, one may want to know whether there exists any correlation between size of holdings and percentages of holdings growing different crops (or area under these crops). It is estimated that there is a correlation between size of holdings and percentages of holdings growing different crops. For example, teff is reported by 35.6% of holdings in the first area group, 42.5% in the second group, 60.5% in third group, 72.6% in fourth group, 81.1% in the sixth group, and 84.2% in the seventh area group, while maize is more frequently reported in lower area groups. The details for all crops are given in table 10.

One may observe similar correlation between size of holdings and percentages of area under different crops. On the average, 13.8% of total area is under maize, but 34.5% of total area under crops is group 1, 35.4% in the second group, 25.1% in the third group, 14.2% in the fourth group, 8.8% in the fifth group, and 9.7% in the sixth group and none in the seventh group. The details for other crops are given in table 11.

4.5 Land Utilization by Size of Total Area

All land occupied by holdings was classified, as mentioned at the beginning of this chapter, into three main groups:

- (i) cropland which occupies 4,382.3 thousand hectares is 73.4% of total area of the holdings,

Table 9

NUMBER OF HOLDINGS GROWING DIFFERENT CROPS AND AREA
OF CROPLAND UNDER THESE CROPS

Crop	Number of holdings reporting crops		Area under crops	
	Thousand	Per cent	Thousand hectares	Per cent
(1)	(2)	(3)	(4)	(5)
Teff	3,056.0	59.6	1,353.2	30.9
Barley	1,249.2	24.4	507.3	11.6
Wheat	880.2	17.2	335.3	7.6
Maize	2,303.5	44.9	604.6	13.8
Sorghum	1,771.9	34.5	585.8	13.4
Millet	762.1	14.9	272.0	6.2
Horse beans	611.9	11.9	164.3	3.7
Chick peas	417.1	8.1	124.8	2.8
Haricot beans	212.5	4.1	27.7	0.6
Field peas	358.0	7.0	80.7	1.8
Lentils	197.7	3.9	44.6	1.0
Flax	215.4	4.2	69.2	1.6
Neug	330.1	6.4	181.9	4.2
Sesame	9.7	0.2	11.1	0.3
Others	106.4	2.1	19.8	0.5
<u>Total Cropland</u>	<u>5,129.8</u>	<u>100.0</u>	<u>4,382.3</u>	<u>100.0</u>

Table 10

NUMBER OF HOLDINGS GROWING MAJOR CROPS BY SIZE OF TOTAL AREA

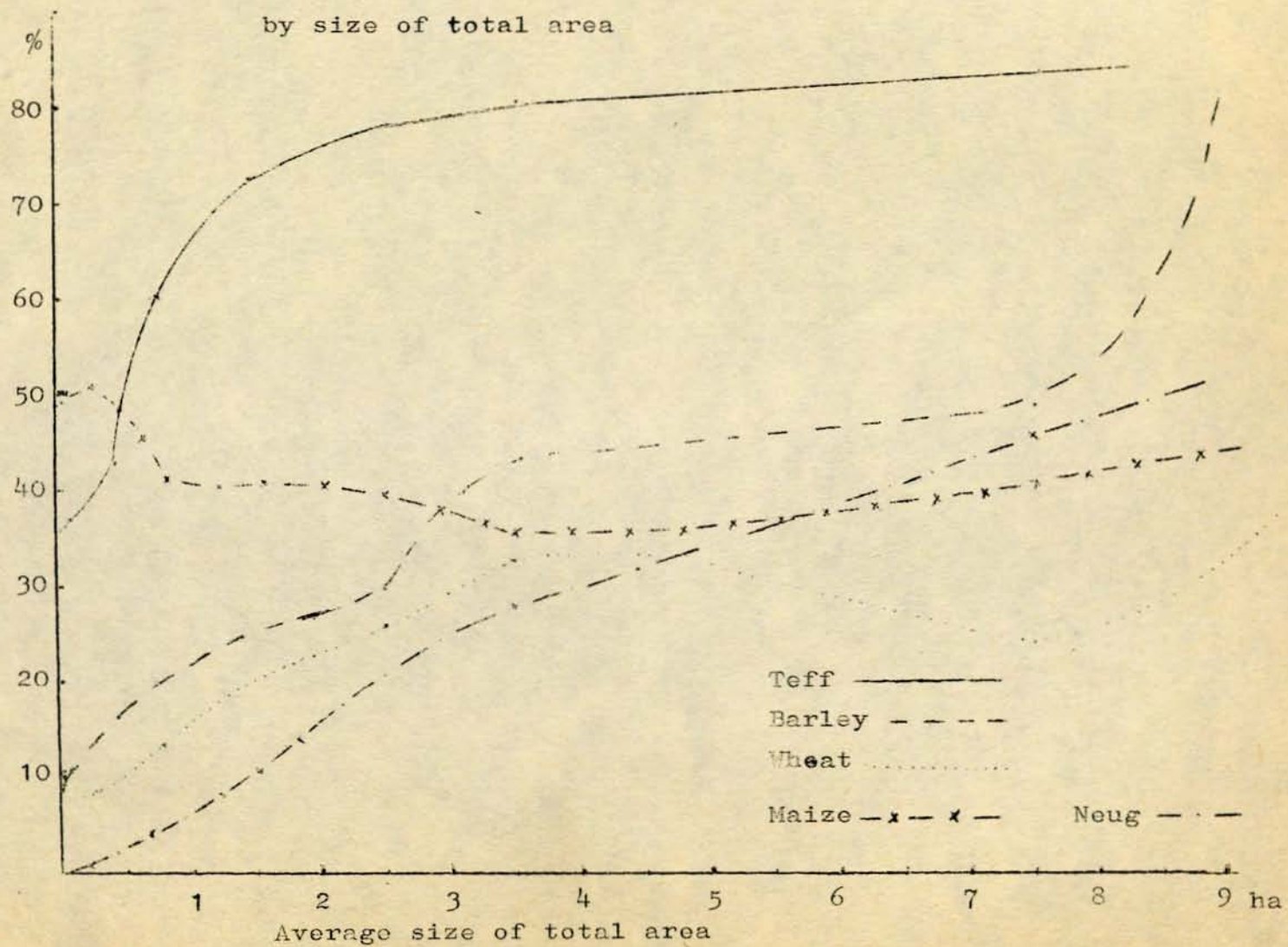
Holdings Crop	Holdings by size of total area (in hectares)							Total
	Under 0.10	0.11 -0.50	0.51 -1.00	1.01 -2.00	2.01 -5.00	5.01 -10.00	10.01 above	
Number of holdings	In thousand							
	159.4	1744.5	1211.7	1138.3	790.1	82.9	2.9	5129.8
	Percentages in total number of holdings in the group							
Teff	35.6	42.5	60.5	72.6	81.1	84.2	-	59.6
Barley	10.6	12.9	19.6	33.2	42.6	47.3	100.0	21.7
Wheat	8.3	7.3	13.2	26.2	32.6	24.3	50.0	17.2
Maize	49.2	51.8	40.8	40.8	35.2	41.9	-	44.9
Bengal	21.2	29.2	43.1	37.2	32.6	24.3	-	34.5
Millet	-	5.6	16.3	19.9	26.3	40.5	-	14.9
Horse beans	5.3	7.0	10.5	15.0	21.2	13.5	50.0	11.9
Chick peas	-	2.0	5.2	10.3	17.5	16.2	-	8.1
Haricot beans	3.0	3.9	4.6	0.1	5.2	1.4	-	4.1
Field peas	3.0	2.7	3.2	9.6	14.0	24.3	-	7.0
Lentils	2.3	1.6	2.6	3.7	10.1	6.8	-	3.9
Flax	-	0.5	1.7	3.3	12.7	28.4	-	4.2
Neug	-	0.7	3.5	10.9	28.1	44.6	-	6.4
Sesame	-	-	0.1	0.1	0.7	2.7	-	0.2
Others	-	0.4	1.3	4.5	4.0	2.7	-	2.1

Table 11

AREA OF HOLDINGS GROWING MAJOR CROPS BY SIZE OF TOTAL AREA

Area Crop	Holdings by size of total area (in hectares)							
	Under 0.10	0.11 -0.50	0.51 -1.00	1.01 -2.00	2.01 -5.00	5.01 10.00	10.01 & above	Total
Total area of cropland	In thousand							
	9.6	410.6	680.1	1214.8	1724.1	336.1	7.0	4382.3
	Percentages in total area of cropland in the group							
Teff	23.8	25.2	29.2	31.2	31.6	35.1	-	30.9
Barley	4.8	6.5	8.7	13.7	12.7	9.1	38.9	11.6
Wheat	14.9	4.0	5.3	10.3	8.7	5.1	35.9	7.6
Maize	34.5	35.4	25.1	14.2	8.8	9.7	-	13.8
Sorghum	12.3	19.4	17.1	11.4	9.2	6.0	-	13.4
Millet	-	2.3	5.2	4.9	7.1	10.2	-	6.2
Horse beans	3.5	3.1	3.3	4.3	4.3	2.0	25.2	3.7
Chick peas	-	1.0	2.0	2.2	3.8	3.5	-	2.8
Haricot beans	2.5	0.9	0.8	0.5	0.7	0.6	-	0.6
Field peas	3.0	0.9	1.3	2.1	2.1	3.0	-	1.8
Lentils	0.7	0.7	0.9	0.7	1.6	0.8	-	1.0
Flax	-	0.3	0.5	0.9	2.2	4.4	-	1.6
Neug	-	0.2	0.3	0.1	6.2	9.4	-	4.2
Sesame	-	-	0.0	2.8	0.5	1.0	-	0.3
Others	-	0.1	0.3	0.7	0.4	0.1	-	0.5

Fig. 4. Percentages of holdings growing selected crops by size of total area



- (ii) fallow land which occupies 994.1 thousand hectares, is 16.6% of total area of the holdings,
- (iii) other land which occupies 597.0 thousand hectares, is 10.0% of total area.

These estimates were obtained according to farmers' reporting during interview, as mentioned several times, are commonly underestimated. After area correction, cropland is estimated at 5,606.0 thousand hectare fallow land - 1,268.7 thousand hectares, and other land- 777.4 thousand hectares. The details are given in table 12.

Table 12

TOTAL AREA OF HOLDINGS BY TYPE OF LAND

Type of land	Total area			
	according to farmers' reporting		corrected according to area measurement	
	Thousand hectares	per cent	thousand hectares	per cent
(1)	(2)	(3)	(4)	(5)
Total land	5,973.4	100.0	7,652.1	100.0
Cropland	4,382.3	73.4	5,606.0	73.3
Fallow land	994.1	16.6	1,268.7	16.6
Other land	597.0	10.0	777.4	10.1

The variation in land-use pattern between the different area groups of holdings can be examined by reference to percentage distribution of area of holdings under different land-use.

The percentages of area under cropland area rather higher for the holdings in lower area groups than for larger ones: nearly 85% of area under crop fall in the first area group. While the highest area group is less than 50%. The details for reported area, and corrected area are given in table 13 and 14 respectively.

4.6 Fragmentation of Holdings

Fragmentation is measured in terms of holding's separated into independent parcels, often scattered over a wide area. Fragmentation is a very serious problem in some region of Ethiopia because it involves waste of time and efforts in travelling from one parcel to the other and makes working on them uneconomical. (see the Annex).

The average number of parcels per holding is 2.42 for the country as a whole; whereas the average number of parcels in the first area group is 1.11 and 4.42 in the sixth area group.

It is estimated that 38.7% of all holdings consist of one parcel. About 20.2% of the holding have 4 parcels or more. The details are given in table 15.

4.7 Uses of Fertilizers

Farmers were asked whether they apply fertilizers or not and the kind of fertilizer they apply (commercial or natural) on their fields. They were not asked how much fertilizers they applied.

Table 13

AREA OF HOLDINGS BY SIZE OF TOTAL AREA AND TYPE OF LAND

Type of land	Holdings by size of total area (in hectares)							
	Under 0.10	0.11 -0.50	0.51 -1.00	1.01 -2.00	2.01 -5.00	5.01 -10.00	10.01 & above	Total
	Area in hectares per holding							
Total land	0.068	0.310	0.735	1.430	2.968	6.418	13.550	1.164
Cropland	0.056	0.237	0.565	1.070	2.184	4.010	2.690	0.854
Fallow land	0.001	0.023	0.090	0.226	0.525	1.705	2.300	0.194
Other land	0.011	0.050	0.080	0.134	0.259	0.703	8.560	0.116
	Per cent of total land							
Cropland	82.4	76.5	76.9	74.8	73.6	62.5	19.9	73.4
Fallow land	1.4	7.4	12.2	15.8	17.7	26.6	17.0	16.6
Other land	16.2	16.1	10.9	9.4	8.7	10.9	63.1	10.0

Table 14

CORRECTED AREA OF HOLDINGS BY SIZE OF TOTAL AREA AND TYPE OF LAND

Type of land	Holdings by size of total area (in hectares)							
	Under 0.10	0.11 -0.50	0.50 -1.00	1.01 -2.00	2.01 -5.00	5.01 -10.00	10.01 above	Total
	Area in hectares per holding							
Total land	0.072	0.426	0.728	1.426	3.048	6.436	12.338	1.492
Cropland	0.061	0.324	0.558	1.069	2.281	4.511	5.768	1.093
Fallow land	0.002	0.026	0.078	0.220	0.515	1.375	1.909	0.247
Other land	0.009	0.076	0.092	0.137	0.252	0.550	4.661	0.152
	Per cent of total land							
Cropland	84.7	76.1	76.7	75.0	74.8	70.1	46.7	73.3
Fallow land	2.8	6.1	10.7	15.4	16.9	21.4	15.5	16.6
Other land	12.5	17.8	12.6	9.6	8.3	8.5	37.8	10.1

Table 15

HOLDINGS ACCORDING TO NUMBER OF PARCELS AND AVERAGE NUMBER OF PARCELS PER
HOLDING BY SIZE OF TOTAL AREA

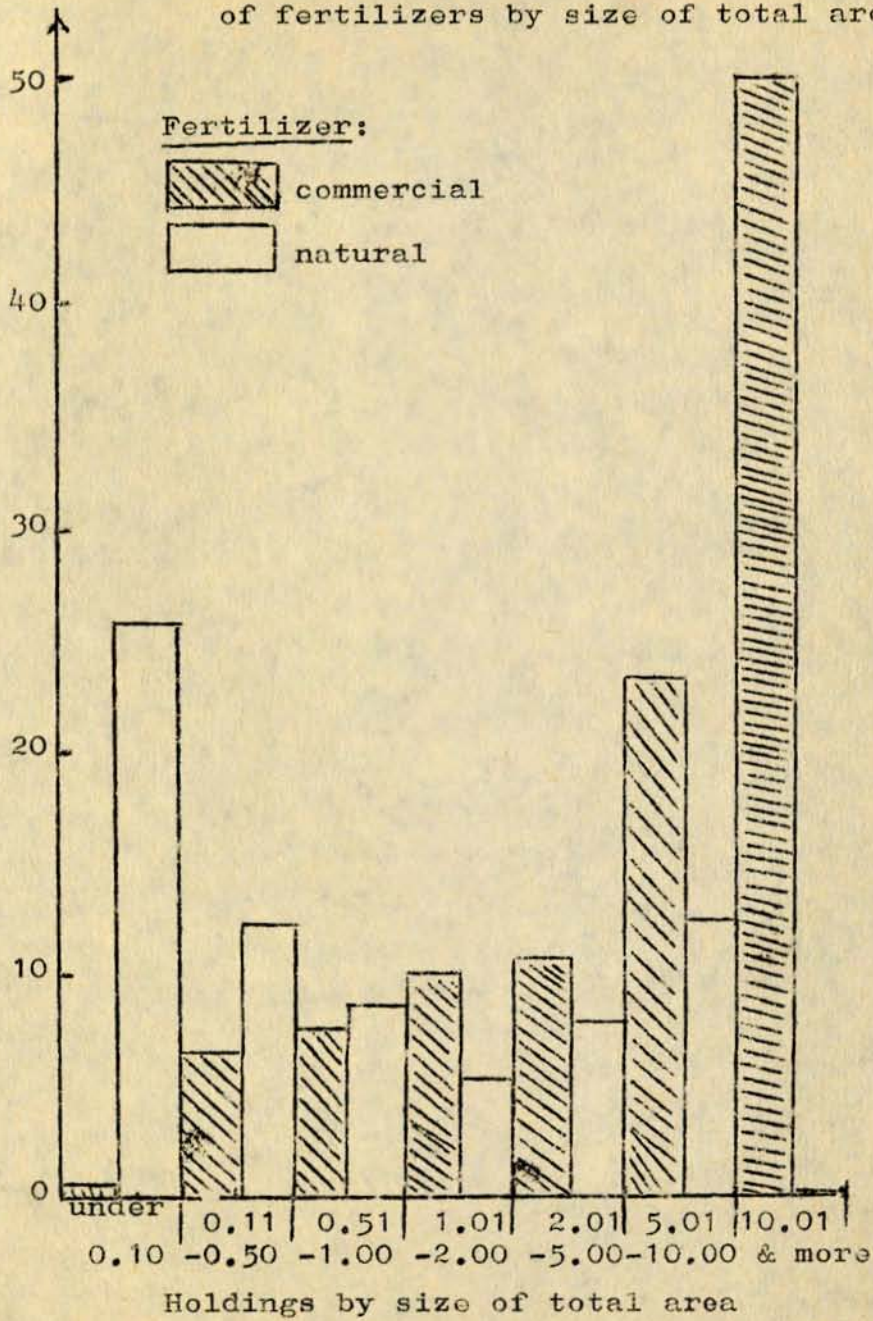
Number of holdings with:	Holdings by size of total area (in hectares)							
	Under 0.10	0.11 to 0.50	0.51 to 1.00	1.01 to 2.00	2.01 to 5.00	5.01 to 10.00	10.01 & above	Total
	Per cent of holdings							
1 parcel	90.2	63.7	36.4	19.7	9.1	9.2	-	38.7
2	8.3	25.0	31.9	23.3	15.7	14.5	-	24.1
3	1.5	6.8	19.6	28.2	22.5	7.9	50.0	17.0
4-5 Parcels	-	4.2	8.9	23.1	30.7	39.5	50.0	14.2
6-9	-	0.3	2.7	5.2	20.5	27.6	-	5.5
10 & more	-	-	0.5	0.5	1.4	1.3	-	0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Average number of parcels							
per holding	1.11	1.54	2.19	2.87	3.83	4.42	3.50	2.42

According to our findings less than one percent (.7%) of the holdings in the first area group, 6.0% in the second, 7.6% in the third, 10.1% in the fourth, 10.5% in the fifth, 23.0% in the sixth and 50% in the seventh used commercial fertilizer, whereas, 26.5% of holding in the first area group applied natural fertilizers. The details are given in table 16 .

Commercial fertilizers were commonly applied on 11.6% of total area under teff, 11.8% under barley, 7.6% under teff, 9.9% under millet and 3.4% under maize. This comprise 5.9% of the total area under crop.

Natural fertilizers were commonly applied on 8.5% of the total area under maize, 6.0% under barley, 3.3% of millet and 3.6% under haricot beans, This comprises 3.2% of total area under crop. For details see table 17.

Fig. 5. Percentages of holdings using different kind of fertilizers by size of total area



Tbale 16

PERCENTAGES OF HOLDINGS USING DIFFERENT KIND OF FERTILIZERS AND AREA OF CROPLAND UNDER FERTILIZERS BY SIZE OF TOTAL AREA

Type of fertilizer	Holdings by size of total area (in hectares)							
	Under 0,10	0,11 0,50	0,51 1,00	0,01 2,00	2,01 5,00	5,01 10,00	10,01 & above	Total
	Percentage of total number of holdings in group							
Commercial	0.7	6.0	7.6	10.1	10.5	23.0	50.0	8.3
Natural	26.5	11.7	8.2	5.5	7.9	12.2	-	9.3
Both	0.7	0.4	0.3	0.6	0.3	2.7	-	0.5
	Percentage of area under fertilizer							
Commercial	0.6	4.2	4.7	5.8	5.9	10.6	49.1	5.9
Natural	47.4	6.6	4.5	2.1	2.4	4.2	-	3.2
Both	0.5	0.2	0.2	0.2	0.2	0.9	-	0.3

Table 17

PERCENTAGES OF AREA UNDER DIFFERENT KIND OF
FERTILIZERS BY CROPS

Crop	Type of fertilizers		
	Commercial	Natural	Both
(1)	(2)	(3)	(5)
Teff	7.6	1.7	0.3
Barley	11.8	6.0	0.1
Wheat	11.6	0.6	0.3
Maize	3.4	8.5	0.2
Sorghum	0.6	1.2	0.0
Millet	9.9	3.3	1.0
Horse beans	0.3	2.4	-
Chick peas	-	0.5	-
Haricot beans	0.9	3.6	0.3
Field peas	0.3	0.5	-
Lentils	2.1	-	-
Flax	1.8	2.6	0.9
Neug	1.3	3.7	0.4
Sesame	-	-	-
Others	-	4.0	-
Total Cropland	5.9	3.2	0.3

Chapter V

COMPARISON OF AREA, YIELD AND PRODUCTION OF MAJOR CROPS IN YEARS 1974/75 AND 1975/76

5.1 Introduction

Area under major crops, yield and production of these crops were estimated for 1974/75 (1967 E.C.) from the data collected during the agricultural sample survey last year (see [1]). The same data are presented in chapter III of this report for 1975/76 (1968 E.C.). Therefore, it would be useful to compare relevant characteristics between the two consecutive years.

Users of crop production data are usually interested in comparisons of the area under crops, yield and production of these crops in different years. It is very important to know whether production, for instance of teff, increased or decreased comparing to last year. Comparison of the crop production data is very important and should be done correctly. Since the relevant characteristics connected with crop production data are usually estimated on the sampling basis, it is necessary to take into account that observed differences between years are subject to sampling errors. These differences might be not significant, if even at the first glance they seem rather large. For this reason we warn the users of the data have to be very careful with interpretations and conclusions.

There are some statistical tests which enable us to verify whether observed differences are significant or not. However, application of these tests in practice is connected with time consuming calculation. Since the

data were processed by hand, it was impossible to include them in this report, Nevertheless, we decided to compare the most important characteristics using rough but simplified method.

5.2 Remarks on the Comparison Method

It is necessary to take size of samples, sample designs and method of estimation into account before starting the comparison of estimates of different characteristics connected with area, yield and production of major crops between two years. We should decide how to compare the results, i.e. what method of comparison we are able to apply.

In 1974/75 the data concerning area under major crops, yield and production of these crops were collected from 2,741 holdings using interview method, 1,907 selected field were measured to correct area, and 63 crop-cutting experiments were conducted to correct yield, whereas in 1975/76 the relevant figures are as follows: 4,352 holdings, 3,463 field area measurements, and 871 crop-cutting experiments.

Sampling design and method of estimation were the same in both years, but 30 weredas (primary sampling units) out of 45 were retained in both years to increase the efficiency of dynamic analysis (i.e. comparison between years). The data were generalized on the same population, i.e. 452 agriculturally important weredas.

We have confined ourselves to the presentation of estimates of relevant characteristics in year 1974/75 (column 2) and in year 1975/76 (column 3), the diff-

erence between these estimates (i.e. estimate for 1975/76 minus estimate for 1974/75-in column 4), and percent of difference i.e. difference (in column 4) divided by estimate in 1974/75 (in column 2) and multiplied by 100. Per cent of the difference is given in column 5.

5.3 Comparison of Area Under Major Crops

Total area under major crops is the same for both years, i.e. 5.6 million hectares, but there are some differences on the area under different crops. Since the estimates for both years were calculated on sampling basis, and the size of the sample was rather small, we suggest the following criteria that differences less than 15% for teff, barley, maize, wheat and sorghum should not be considered as significant, whereas differences less than 20% for millet, horse beans and chick peas and differences less than 25% for other crops.

Using the above criteria there is significant increase of the area under teff, millet, flax and neug, but significant decreased of area under barley, wheat, haricot beans and lentils. There is not significant difference under other crops. The details are given in table 18 .

5.4 Comparison of Yield of Major Crops

Comparison of yields in 1974/75 and 1975/76 is more difficult than area. In 1974/75 we got 66 crop-cutting experiments only and yield was corrected in two ways: using crop-cutting experiment results and adjusted crop-cutting correction (see [1] , p.82).

Table 18

COMPARISON OF AREA UNDER MAJOR CROPS IN YEARS
1974/75 (1967 E.C.) AND 1975/76 (1968 E.C.) BY CROPS

Crop	Area under crop in		Changes	
	1974/75	1975/76	Col.3-Col.2	$\frac{\text{Col.4}}{\text{Col.2}} \times 100$
	Thousand hectares			Per cent
(1)	(2)	(3)	(4)	(5)
Teff	1,451	1,721	+270	+18.6
Barley	809	601	-208	-25.7
Maize	759	728	- 31	- 4.1
Wheat	702	500	-202	-28.8
Sorghum	697	718	+ 21	+ 3.0
Millet	174	316	+142	+81.6
Horse beans	320	259	- 61	-19.1
Chick peas	177	198	+ 21	+11.9
Field Peas	108	107	- 1	- 0.9
Haricot beans	70	42	- 28	-40.0
Lentils	116	56	- 60	-51.7
Flax	50	82	+ 32	+64.0
Neug	95	226	+131	+137.9
Others	54	52	- 2	- 3.7
Total Cropland	5,582	5,606	+ 24	+ 0.4

For comparison we have applied both methods, however, for each comparison we selected estimate which had highest value.

According to above method there is no significant difference in yield estimates for teff, millet, haricot beans and flax in both years, but there is significant increase in yield for maize, barley, wheat, sorghum, horse beans and neug. Significant decrease is observed only for chick peas and field peas. Details are given in table 19.

5.5 Comparison of Production of Major Crops

Changes in crop production depend on changes on area under crop or yield per hectare or both. The estimates of total production under major crops in 1974/75 was 45.8 million quintals, whereas in 1975/76 was 52.5 million quintals. On the average, increase of total production is estimated to be 6.7 million quintals (i.e. 14.6%). Using the same criteria suggested in section 5.3, one may observe significant increase in production for teff (16.5%), maize (37.1%), sorghum (23.9%), millet (88.3%), flax (59.4%) and neug (216.0%). Significant decrease in production may be observed for wheat (-47.2%), chick peas (-27.0%), and haricot beans (-33.1%). There is no significant decrease observed for barley (-8.2%), and lentils (-14.8%). Details are given in table 20.

Table 19

COMPARISON OF YIELDS OF MAJOR CROPS IN YEARS
1974/75 (1967 E.C.) AND 1975/76 (1968 E.C.) BY CROPS

Crop	Yield in:		Changes	
	1974/75	1975/76	Col.3-Col.2	$\frac{\text{Col.4}}{\text{Col.2}} \times 100$
Y	Quintals per hectares			Per cent
(1)	(2)	(3)	(4)	(5)
Teff	7.0	6.9	-0.1	- 1.4
Barley	7.5	9.3	+1.8	+24.0
Maize	12.6	18.0	+5.4	+42.8
Wheat	8.3	9.8	+1.5	+18.1
Sorghum	9.3	11.1	+1.8	+19.4
Millet	9.5	9.3	-0.2	- 2.1
Horse beans	8.7	10.9	+2.2	+25.3
Chick peas	7.9	5.1	-2.8	-35.4
Field peas	4.8	3.8	-1.0	-20.8
Haricot beans	6.9	6.9	0.0	0.0
Lentils	4.3	7.3	+3.0	+69.8
Flax	3.5	3.4	-0.1	- 2.9
Neug	2.5	3.4	+0.9	+36.0

Table 20

COMPARISON OF CROP PRODUCTION OF MAJOR CROPS IN YEARS
1974/75 (1967 E.C.) AND 1975/76 (1968 E.C.) BY CROPS

Crop	Crop production in		Changes	
	1974/75	1975/76	Col.3-Col.2	$\frac{\text{Col.4}}{\text{Col.2}} \times 100$
	Thousand quintals			Per cent
(1)	(2)	(3)	(4)	(5)
Teff	10,157	11,829	+1,672	+16.5
Barley	6,068	5,568	- 500	- 8.2
Maize	9,563	13,106	+3,543	+37.1
Wheat	5,827	4,822	-1,005	-17.2
Sorghum	6,482	8,034	+1,552	+23.9
Millet	1,653	3,112	+1,459	+88.3
Horse beans	2,784	2,866	+ 82	+ 2.9
Chick peas	1,398	1,021	- 377	-27.0
Haricot beans	483	323	- 160	-33.1
Field peas	518	400	- 118	-22.8
Lentils	499	425	- 74	-14.8
Flax	175	279	+ 104	+59.4
Neug	238	752	+ 514	+216.0
Total Production	45,845	52,537	+6,692	+ 14.6

Chapter VI

SAMPLING AND NON-SAMPLING ERRORS

6.1 Sources of Errors in the Survey

As in any type of sample survey, the crop production survey is subject to different type of errors. Generally speaking, the sources of errors in a sample survey are divided into two main groups. These groups are: (1) sampling errors, and (2) non-sampling errors.

These type of errors exist in all statistically designed survey. Therefore, the most important task of a statistician is to design a sample survey that would minimize these errors.

Sampling errors occur because we are investigating only a part out the whole population. The results that we get by investigating a sample may differ from the results that we get by investigating the whole population. The difference between these results are known as sampling errors. For selected sample we do not know magnitudes of these sampling errors, but we can calculate average magnitudes of these sampling errors which can be calculated from the detailed results obtained from the sample. The magnitude of sampling errors depends upon:

- (a) sample size, in general the larger the sample size the smaller the sampling error, other things being equal;
- (b) sample design;
- (c) method of estimation;
- (d) variability of the characteristic.

It is difficult to fulfil all the prerequisites of having a smaller sampling error or having higher precision of the estimates in practice. In our case, we had a number of limitations of this nature, the details of these are explained in chapter II.

To show the magnitude of the sampling errors, we have selected the most important characteristics connected with area, yield and production of major crops and calculated their errors which are presented in the following section.

Every stage of a survey is a potential source of non-sampling errors. They may occur during the preparation of the survey, training, interviewing, supervision, editing, processing, analysis, etc. It is very difficult to discover the magnitude of non-sampling errors but they could be minimized by having proper control under each stage of the survey. Post enumeration surveys are conducted to calculate the magnitude of non-sampling errors; however, this type of surveys are normally expensive and required highly trained enumerators. We did not conduct post enumeration survey in our case for the reason mentioned above. In any case efforts were made to observe all stages of the survey to discover some sources of errors which might influence the results. Non-sampling errors are discussed in detail in section 6.3 .

6.2 Estimates of Sampling Errors for Selected Characteristics

The sampling errors (standard errors) presented in this section are calculated according to method described in chapter II (Estimation of sampling errors). Calculation of sampling errors is time consuming and expensive

especially in case, where we have complicated sample design. Therefore, to save time and simplify calculations, we have applied a technique known as interpenetrating sub-samples.

In case of interpenetrating sub-samples, sample estimates for each of the sub-samples are calculated; the variation between the overall estimate and these estimates provides a mean of assessing the precision of each estimate.

Five sub-samples were selected at random to form the interpenetrating samples and each sub-sample consisted of 9 primary sampling units (weredas). The calculation of standard error was performed as follows:

$$s(\bar{x}) = \sqrt{\frac{\sum_{i=1}^m (\bar{x}_i - \bar{x})^2}{m(m-1)}}$$

where \bar{x}_i is the estimate for the i-th sub-sample and \bar{x} is the overall estimate calculated as follows:

$$\bar{x} = \frac{1}{m} \sum_{i=1}^m \bar{x}_i$$

and m is the number of sub-sample (in our case m = 5).

Standard errors of estimates of area under major crops calculated according to above formula are given in table 21 whereas standard errors of percentages of area of major crops are presented in table 22. In column 2 estimates of characteristics are given, in

column 3 - standard errors of these estimates, and in column 4 - relative standard errors (in per cent).

Relative standard error for the estimate of total area under major crops (total cropland) is 9.1%, whereas for area under different crops varies from 10.6% for maize to 42.6% for chick peas).

Relative standard errors for the estimates of percentages of area under major crops vary from 12.5% for teff to 41.9% for lentils .

Table 21

ESTIMATES OF AREA UNDER CROPS, THEIR STANDARD ERRORS AND RELATIVE STANDARD ERRORS BY CROPS

Crop	Estimate	Standard error	Relative standard error
	Thousand hectares		Per cent
(1)	(2)	(3)	(4)
Teff	1,721	296	17.2
Barley	601	71	11.8
Maize	728	77	10.6
Wheat	500	157	31.4
Sorghum	718	95	13.3
Millet	317	101	31.8
Horse beans	259	102	39.4
Chick peas	198	84	42.6
Haricot beans	42	13	30.0
Field peas	107	30	28.1
Lentils	56	18	31.7
Flax	82	24	29.6
Neug	226	54	23.9
Total Cropland	5,606	510	9.1

Table 22

PERCENTAGE OF AREA UNDER MAJOR CROPS, THEIR
STANDARDS ERRORS AND RELATIVE STANDARD ERRORS
BY CROPS

Crop	Estimate	Standard error	Relative standard error
	Percentages		Per cent.
(1)	(2)	(3)	(4)
Teff	30.7	3.8	12.5
Barley	10.7	1.6	15.0
Maize	13.0	1.7	13.4
Wheat	8.9	2.3	26.1
Sorghum	12.8	2.5	19.5
Millet	5.7	1.5	26.5
Horse beans	4.6	1.8	39.0
Chick peas	3.5	1.4	41.3
Haricot beans	0.8	0.2	32.3
Field peas	1.9	0.7	38.0
Lentils	1.0	0.4	41.9
Flax	1.5	0.6	36.7
Neug	4.0	0.7	17.7

Estimates of yield for major crops, their standard errors and relative standard errors are presented in table 23. The smallest relative standard error is for teff (6.7%) and the highest for haricot beans (37.1%). On the average, the relative standard errors for yield of major crops are smaller than relative standard errors for area under different crops.

Relative standard errors for crop production which are given in table 24 are usually higher than relevant relative standard errors for area under crops and yields. For crops such as teff, barley and maize relative standard errors of production are about 20%; whereas, for wheat it is rather high (35.8%). The standard error of production is the highest for chickpeas (40.3%), and the smallest for haricot beans (16.1%).

Since we investigated the same 30 weredas in both years and correlation between consecutive years is usually high (over 0.7), the standard errors for the differences between relevant characteristics in years 1974/75 and 1975/76 (presented in chapter V) might be much smaller than standard errors for characteristics in year in question.

The precision of the estimates of the characteristics of interest might not be very satisfactory. This could be due to two factors:

- i) our sample size is not large enough,
- ii) our sample design is a three-stage selection of units and the first-stage sampling units (weredas) are heterogeneous from the size point of view. Precision of these estimates could have improved easily if we had used

administrative sub-division as primary sampling units. However, we were not in a position to do so when we conducted this survey for the simple reason that it is very costly to prepare such frame.

Table 23

ESTIMATES OF YIELDS, THEIR STANDARD ERRORS AND
RELATIVE STANDARD ERRORS BY CROPS

Crop	Estimate	Standard error	Relative standard error
	Quintals per hectare		Per cent
(1)	(2)	(3)	(4)
Teff	6.9	0.5	6.7
Barley	9.3	0.9	9.8
Maize	18.0	2.2	12.4
Wheat	9.6	1.5	16.1
Sorghum	11.2	2.0	18.2
Millet	9.8	2.0	20.5
Horse beans	11.1	1.9	16.9
Chick peas	5.2	1.0	18.5
Haricot beans	7.6	2.8	37.1
Field peas	3.7	1.1	29.3
Lentils	7.6	2.6	34.2
Flax	3.4	1.0	29.7
Neug	3.3	0.7	19.7

Table 24

ESTIMATES OF CROP PRODUCTION, THEIR STANDARD ERRORS AND RELATIVE STANDARD ERRORS BY CROPS

Crop	Estimate	Standard error	Relative standard error
	Thousand quintals		Per cent
(1)	(2)	(3)	(4)
Teff	11,829	2,354	19.9
Barley	5,568	1,002	18.0
Maize	13,106	2,739	20.9
Wheat	4,821	1,726	35.8
Sorghum	8,034	2,057	25.6
Millet	3,112	725	23.3
Horse beans	2,866	908	31.7
Chick peas	1,021	411	40.3
Haricot beans	323	52	16.1
Field peas	400	125	31.2
Lentils	425	150	35.3
Flax	279	88	31.7
Neug	752	204	27.1

6.3 Main Sources of Non-sampling Errors in the Survey

It is very important to describe the condition under which this survey was conducted for this contributes a lot to the quality of the statistical data one can get.

There was a very limited number of personnel, vehicles and equipments available in the Ministry. Therefore, additional manpower, vehicles and equipment were supplemented by other agencies (mainly CSO).

The main limiting factor, however, was the lack of adequate frame. There was no list of enumeration areas or farm holdings available for sample selection. List of administrative sub-divisions were out of date and had to be updated in the field. List of holdings in the selected administrative sub-divisions were supposed to be prepared by house to house visit; however, it has been discovered during field supervision that some enumerators have used memory list instead. As a result of that, it is possible that some holdings might be missed and the number of holdings could be underestimated. On the other hand, some enumerators used a list of members of Farmers' Associations as a frame for holding selection. Sometimes from the same holding two or more persons were members of Farmers' Association, and this might give overestimation of the number of holdings.

The second source of non-sampling errors was non-response. Out of 5,130 holdings selected 4,452 only were accepted for processing (i.e. 86.8%). The breakdown is as follows: 6.3% not contacted, 5.8% refusals, 1.1% rejected during editing. Out of the 4,360 fields selected for area measurements 3,463 were accepted (79.5% %) as correctly done.

Another source of non-sampling errors was from interview of farmers. Area under different crops and yield of these crops were significantly underestimated. To correct this field area measurements and crop-cutting experiments were conducted. On the average, area under major crops was underestimated by 28% (from 14% to 81%). Yields calculated according to farmers' reporting were also significantly underestimated from 16% to 139%. However, area and yield were corrected using appropriate correction coefficients.

Last but not least the enumerators were also source of non-sampling errors. Enumerators played a great role in the efficiency of the survey. Despite all the efforts made to organize the survey, it was difficult to ensure adequate training in the field and control them effectively.

6.4 Concluding Remarks

Crop production survey was conducted more efficiently than last agricultural sample survey. In 1974/75 only 2,741 holdings were interviewed, 1,907 field area measurements were conducted, and crop-cutting experiments were carried out on 126 plots, whereas in 1975/76 the particulars are as follows: 4,452 holdings were interviewed (62.4% more), 3,453 field area measurements (81.6% more), and 1,742 plots (871 fields) were harvested during crop-cutting experiments (13.8 times more). There was lack of adequate field equipment and survey equipment which influenced the results significantly. Field supervision was also not properly done and should be improved in the future. Despite of all of these weaknesses the results that we got are very useful because they are collected using scientific method.

REFERENCES

- [1] Agricultural Sample Survey 1974/75 (REPORT), vol.I and vol.II, Addis Ababa, 1975.
- [2] Crop Production Survey 1975/76 - Instruction Manual, Ministry of Agriculture and Forestry Development, Addis Ababa, 1975.
- [3] Estimation of Area in Agricultural Statistics, FAO, Rome, 1954.
- [4] Metric Equivalents of Local Area and Production Units, STATISTICAL BULLETIN 7, Central Statistical Office, Addis Ababa, 1972.
- [5] Panse, V.G.: Estimation of Crop Yield, FOA, Rome, 1954.
- [6] Report on the 1960 World Census of Agriculture, vol.III, Methodology, FAO, Rome, 1969.
- [7] Zarkovich, S.S.: Estimation of Area in Agricultural Statistics, FAO, Rome, 1965.

A N N E X I

THE RESULTS
OF CROP PRODUCTION SURVEY 1975/76
BY REGIONS

1. Northern Region (Eritrea, Tigre, Wollo).
2. North-Western Region (Begemdir, Gojam).
3. Central-Western Region (Shoa, Wellega).
4. Eastern Region (Arussi, Hararghe).
5. South-Western Region (Illubabor,
Keffa).
6. Southern Region (Gemu Gofa, Sidamo, Bale).

Table 1.1

ESTIMATES OF AREA, PRODUCTION AND YIELD OF MAJOR CROPS ACCORDING TO FARMERS' REPORTING IN NORTHERN REGION

Crop	Area	Production	Yield
	Thousand hectares	Thousand quintals	Quintals Per ha.
(1)	(2)	(3)	(4)
Teff	284.6	1,420.1	5.0
Barley	79.5	546.1	6.9
Wheat	31.1	320.3	10.3
Maize	25.1	264.8	10.6
Sorghum	134.0	829.6	6.2
Millet	21.9	207.1	9.5
Horse beans	16.9	122.2	7.2
Chick peas	22.7	74.0	3.3
Haricot beans	1.4	8.5	6.0
Field peas	12.5	92.5	7.4
Lentils	9.4	46.2	4.9
Flax	4.1	21.0	5.1
Neug	2.3	8.9	3.9
Sesame	-	-	-
Others	0.4	1.6	4.3
<u>Total cropland</u>	<u>645.9</u>	<u>3,962.9</u>	<u>6.1</u>

Table 1.2

ESTIMATES OF AREA, PRODUCTION AND YIELD OF MAJOR CROPS ACCORDING TO FARMERS' REPORTING IN NORTH - WESTERN REGION

Crop	Area	Production	Yield
	Thousand hectares	Thousand quintals	Quintals per ha.
(1)	(2)	(3)	(4)
Teff	467.3	1,434.7	3.1
Barley	108.4	266.8	2.5
Wheat	4.7	15.2	3.2
Maize	50.9	121.6	2.4
Sorghum	76.1	319.5	4.2
Millet	205.7	586.1	2.9
Horse beans	13.0	41.9	3.2
Chick peas	49.7	143.7	2.9
Haricot beans	-	-	-
Field peas	34.9	62.9	1.8
Lentils	5.8	8.5	1.5
Flax	29.9	50.8	1.7
Neug	144.9	204.3	1.4
Sesame	11.0	19.7	1.8
Others	1.1	5.8	5.3
<u>Total cropland</u>	<u>1,203.4</u>	<u>5,281.5</u>	<u>2.7</u>

Table 1.3

ESTIMATES OF AREA, PRODUCTION AND YIELD OF MAJOR CROPS ACCORDING TO FARMERS' REPORTING IN CENTRAL WESTERN REGION

Crop	Area	Production	Yield
	Thousand hectares	Thousand quintals	Quintals per ha.
(1)	(2)	(3)	(4)
Teff	336.6	2,073.2	6.2
Barley	150.7	715.7	4.8
Wheat	207.2	1,193.4	5.8
Maize	178.0	1,025.3	7.5
Sorghum	141.0	1,396.8	9.9
Millet	10.6	52.3	4.9
Horse beans	126.5	885.3	7.0
Chick peas	45.3	197.7	4.4
Haricot beans	3.2	31.4	9.7
Field peas	21.0	74.1	3.5
Lentils	26.2	95.1	3.6
Flax	22.1	52.6	2.4
Neug	33.1	66.1	2.0
Sesame	-	-	-
Others	16.3	73.3	4.5
<u>Total cropland</u>	<u>1,317.8</u>	<u>7,931.8</u>	<u>6.0</u>

Table 1.4

ESTIMATES OF AREA, PRODUCTION AND YIELD OF MAJOR CROPS ACCORDING TO FARMERS' REPORTING IN EASTERN REGION

Crop	Area	Production	Yield
	Thousand hectares	Thousand quintals	Quintals per ha.
(1)	(2)	(3)	(4)
Teff	53.0	273.1	5.2
Barley	134.6	901.5	6.7
Wheat	73.1	589.9	8.1
Maize	71.8	483.3	6.7
Sorghum	112.9	1,078.9	9.6
Millet	1.5	9.0	6.0
Horse beans	1.0	4.8	4.8
Chick peas	-	-	-
Haricot beans	14.5	53.8	3.7
Field peas	4.3	10.4	2.5
Lentils	3.1	12.6	4.1
Flax	12.8	74.2	5.8
Neug	-	-	-
Sesame	0.1	0.5	5.0
Others	0.2	1.1	5.0
<u>Total cropland</u>	<u>482.9</u>	<u>3,493.1</u>	<u>7.2</u>

Table 1.5

ESTIMATES OF AREA, PRODUCTION AND YIELD OF MAJOR CROPS ACCORDING TO FARMERS' REPORTING IN SOUTH - WESTERN REGION

Crop (1)	Area	Production	Yield
	Thousand hectares (2)	Thousand quintals (3)	Quintals per ha. (4)
Teff	171.9	986.7	5.7
Barley	12.4	28.5	2.3
Wheat	10.3	34.0	3.3
Maize	213.5	1,543.7	7.2
Sorghum	104.9	781.6	7.5
Millet	32.3	236.7	7.3
Horse beans	4.7	20.4	4.3
Chick peas	4.7	6.0	1.3
Haricot beans	1.6	2.4	1.5
Field peas	7.4	19.1	2.6
Lentils	0.1	0.2	1.9
Flax	0.3	2.0	7.2
Neug	1.6	9.2	5.7
Sesame	-	-	-
Others	1.5	2.5	1.7
<u>Total cropland</u>	<u>567.2</u>	<u>3,673.0</u>	<u>6.5</u>

Table 1.6

ESTIMATES OF AREA, PRODUCTION AND YIELD OF MAJOR CROPS ACCORDING TO FARMERS' REPORTING IN SOUTHERN REGION

Crop	Area	Production	Yield
	Thousand hectares	Thousand quintals	Quintals per ha.
(1)	(2)	(3)	(4)
Teff	39.8	267.7	6.7
Barley	21.7	108.6	5.0
Wheat	8.8	37.9	4.3
Maize	65.3	699.6	10.7
Sorghum	16.9	135.6	8.0
Millet	-	-	-
Horse beans	2.2	8.1	3.7
Chick peas	2.4	10.2	4.3
Haricot beans	7.0	36.7	5.3
Field peas	0.6	5.3	8.7
Lentils	-	-	-
Flax	-	-	-
Neug	-	-	-
Sesame	-	-	-
Others	0.3	0.5	1.6
Total cropland	165.0	1,310.2	7.9

Table 2.1

FIELD AREA MEASUREMENT RESULTS IN NORTHERN REGION

Crop	Number of field measurements	Average area per field according to		Area correction coefficient
		meas- urement in hectares	farmers reprot.	
(1)	(2)	(3)	(4)	(5)
Teff	169	0.308	0.223	1.381
Barley	60	0.306	0.255	1.198
Wheat	32	0.312	0.260	1.199
Maize	33	0.189	0.118	1.597
Sorghum	98	0.302	0.245	1.236
Millet	61	0.201	0.105	1.923
Horse beans	42	0.222	0.131	1.693
Chick peas	26	0.751	0.307	2.449
Haricot beans	3	0.170	0.070	2.318
Field peas	26	0.193	0.178	1.082
Lentils	19	0.395	0.235	1.678
Flax	10	0.201	0.115	1.748
Neug	4	0.533	0.213	2.506
Sesame	-	-	-	-
Others	-	-	-	-
Total cropland	583	X	X	1.574

Table 2.2

FIELD AREA MEASUREMENT RESULTS IN NORTH-WESTERN REGION

Crop	Number of field measurements	Average area per field according to		Area correction coefficient
		measur- ement in hectares	farmers report.	
(1)	(2)	(3)	(4)	(5)
Teff	141	0.614	0.490	1.253
Barley	34	0.387	0.333	1.162
Wheat	--	--	--	--
Maize	29	0.297	0.259	1.147
Sorghum	38	0.674	0.583	1.156
Millet	114	0.516	0.483	1.068
Horse beans	-8	0.330	0.295	1.119
Chick peas	16	0.750	0.394	1.904
Haricot beans	--	--	--	--
Field peas	21	0.409	0.339	1.206
Lentils	7	0.303	0.277	1.094
Flax	17	0.394	0.405	0.973
Neug	100	0.529	0.435	1.216
Sesame	3	2.390	2.380	1.004
Others	--	--	--	--
Total cropland	528	X	X	1.219