AN ANALYSIS OF THE CHANGES IN CROP PRODUCTION PRACTICE OF PEASANT FARMERS UNDER INCREASING POPULATION
The Case Of Hitosa 'Wereda' In Arsi Zone

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An Analysis of the Changing Crop Production Practice of Peasant Farmers Under Increasing Population: The Case of Histosa 'Wereda' in Arsi Zone

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Gezemu Hunde

MEANINGS OF ABBREVIATIONS

AAU	=	Addis Ababa University
AM	=	After Meridian
App.(app.)	=	Appendix
ARDU	=	Arsi Rural Development Unit
CADU	=	Chilalo Agricultural Development Unit
CBE	=	Commercial Bank of Ethiopia
CCI	=	Crop Concentration Index
Coeff.	=	Coefficient
CS	=	Crop Specialization
CSA/CSO	=	Central Statistical Authority/Office
C.V.	=	Coefficient of Variation
Dept.	=	Department
Determmin.	=	Determination
E	=	East
EC	=	Ethiopian Calendar
ESSE	=	Ethiopian Selected Seed Enterprise
Fig.	=	Figure
GDP	=	Gross Domestic Product
Ha.(ha)	=	Hectare(s)
HH(s).	=	Household(s)
IAR	=	Institute of Agricultural Research
Km.	=	Kilometer(s)
L.S	=	Level of significance
MOA	=	Ministry of Agriculture
MOE	=	Ministry of Education
No. (no.)	=	Number
NS	=	Not Significant
OSHO	=	Oromo Self-Help Organization
PA(s)	=	Peasant Association(s)
PM	=	Past Meridian
r	=	Coefficient of correlation
r^2	=	Coefficient of determination
SG-2000	=	Sasakao Global-2000
St. Dev.	=	Standard Deviation

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ABSTRACT

The general objective of the study is to evaluate the condition of crop production practices of peasant farmers under the situation of rapid growth of population and limited land resources. Therefore it assesses the agricultural resources, patterns of rural land uses and croppings, the uses of modern crop production technologies and the farming systems of the peasants and the changes observed. Emphasis is, however, given to the impact of population growth on the land use, farming system, need to the use of modern inputs and agricultural productivity in the study area.

The primary data needed in the study were acquired from field survey using questionnaire and interviews. The secondary data were obtained from base maps, and from the documents of government and non-government offices. To analyse the data statistical measures such as the mean, median, percentile, standard deviation, coefficient of variation, F and t-tests and test for ANOVA, the indices of crop concentration Crop combination and crop specialization, simple and multiple correlation/regression. models are used.

The findings revealed that change in land use types in the last twenty years considered in response to the population growth. The cultivated lands showed an expansion rate of 1.5%/yr at the expense of the grazing and other land uses. Average size of land holding was generally found to be small and decreasing (27.7% of the sample households reported having less than one hectare). The family labour is the basis of all farm activities. The animal labour used are mainly the oxen for cultivation & threshing and the donkeys for transport purposes. However, a few of the peasants use tractors and combiners to supplement the animal labour. Crop rotation method and the chemical fertilizers are widely used to replenish soil fertility. Because most of the peasant farmers are aware of the benefits they get from the use of modern farm inputs, their need to the use of tractors, combiners, chemical fertilizers, selected seeds, pesticides and weed killer chemicals have grown significantly in the area. The cropping pattern was found to be dominated by the area of the cereal crops and showed an increasing dominance. In the change of the cropping pattern, the areal share of wheat increased while of the other crops decreased except of the sorghum which remained unchanged for the last two decades. The mean production amount of a household decreased by about 7.6% whereas the mean production amount that a HH obtained from one hectare of farm increased by about 29.7% as observed from 1977/78 to 1997/98.

Generally as it is disclosed by the study, the land holding sizes and land use patterns, the uses of human and animal labour, the uses of modern farm inputs, the patterns of cropping, and land and labour productivities showed changes within the study area.

The simple correlation results for the changes in the areas of all land use types and of cultivated lands are identified to have strong and positive relations to the changes in the number of rural population. In contrast, the change in the area of grazing lands is identified to have negative relation to population growth.

The analyses of variance computed for the significances of expected variations in the use of modern farm machinery and inputs within the study area confirmed that the variations in the use of chemical fertilizers and tractors to be statistically significant while of the selected seeds and combiners are not.

The results of the simple correlation analyses identified positive and strong interdependence between land productivity and the four selected variables (the use of chemical fertilizers, selected seeds, tractors and combiners). The regression analysis further revealed that these four variables emerged as significant predictors. On the other hand, the results of simple correlation analyses of labour productivity and use of these modern inputs emerged as strong but negatively associated. It is worth mentioning that the four independent variables considered have contributed 99.7% and 91.5% to the respective total variances of land and labour productivities which leave 0.3% and 4.5% of the variances to be explained by other variables which have not been considered in the study. Hence, further research to identify the more significant variables amongst those which have not been considered is advisable.

On the basis of the overall evaluation some recommendations have been presented. The major ones are the need to restructure the farming system in general and to optimally plan the land use by making balance to the various uses according to the priority of the demand in particular; to assist the farmers improve the use of traditional and archaic farm tools; to initiate and support the peasants for the use of modern farm inputs and production technology; to study the feasible ways that help to improve the farmers' access to the use of the modern farm inputs; to introduce the animal feed that can be produced by the peasants; to improve infrastructural facilities; to attract capital investment into the area; to develop agro-industry, irrigation schemes; to integrate agriculture with other income generating occupational activities; and to strictly observe the national population policy (the family planning aspect in particular) and educate the people so as to realize balance between population and resources of the area.

CHAPTER ONE

INTRODUCTION

1.1 STATEMENT OF THE PROBLEM

Ethiopia has a traditional agricultural system which possesses the general characteristics of low or small amounts of production, productivity and consumption. Agriculture occupies a significant position in the general economy of the country, accounting for about 55% of the country's GDP, 90% of the total exports and 80% of the national employment (World Bank, 1995). Thus, it forms the base of livelihood for the majority of the population.

The major characteristics of Ethiopian peasant agriculture include high dependency upon the conditions of natural environment; (such as rains, natural fertility of soils etc), traditional techniques of production, and use of low agricultural inputs. Due to the effects of these characteristics, average amounts of productions of the farmers are small and their per capita consumption are affected. As a result, the capacity of the peasants to improve their centuries old production practices appears limited.

Therefore surplus production that could be obtained for marketing is too low and the capacity of agriculture to feed the rapidly growing population is highly limited, where as there is an observable rising rural population density. There is also a gradual change in rural land use pattern and utilization of locally available natural resources. Hence, one of the major problems of Ethiopian agriculture is how to improve the low levels of production and consumption while still recognizing the limited capacity of the farmers to make use of modern farm inputs, under a general situation of continuing population pressure and rising human-land ratio.

The Ethiopian agricultural production system is highly dominated by small holder subsistence production practices. These practices have major characteristics of small and often fragmented farm plots,use of primitive tool and equipment, production geared to personal needs than to market, lack of alternative seasonal employment opportunities and almost total absence of reserves of either grains or cash (Mesfin, 1991; Fasil,1993). About 95% of the presently cropped land of Ethiopia is cultivated by the private peasant small holders whose production system is mainly based on intensive use of labor and land.The method of production applies very limited modern inputs. Level of

productivity and production is stagnantly low, whereas the food requirement of the country is continuously growing as explained by various scholars (Desalegn, 1991; Mesfin, 1991).

The agricultural households are estimated at about 8.68 million with a national average family size of 5.17(CSA, 1995). The households own fragmented and small sized farm plots with average national size of 1.09 hectares. These small sized and fragmented farm holdings have various adverse effects on amounts of production to be obtained and systems of improved farm inputs to be employed (Gray and Tangri,1970).

In Ethiopian agriculture, there is an increase in man-land ratio as a result of rapid growth of population. This usually result in the decrease of fallow period and forest lands, increased soil degradation and deterioration of biological and physical elements that affect production and productivity (Fasil, 1980; Desalegn, 1984; Dejene, 1986; Clarke, 1968; Brookfield, 1984; Gleave and white, 1969; Westphal, 1975; Raanan, 1971). Hence, under such condition achievement of sustainable increased farm out put through intensification of agriculture by making efficient use of available farm resources such as land, labor, capital and other inputs becomes an inevitable choice (Samia and Woubshet, 1996; Dejene, 1994). However, the problem is that the peasant farmers have limited capacities in applying modern inputs due to their high prices. Rather, the techniques of maintaining land fertility are mainly limited to employing traditional methods which are labor intensive (Desalegn, 1991).

The agricultural practices of crop production and livestock raising of Ethiopia are closely integrated activities as 78% of the total peasant holders practice mixed farming (CSA, 1995). Such practices would give the peasant major benefits as livestock provides draft and transportation power and animal dung (which can be used as fertilizer for crop farming and also as fuel). Besides this, the livestock could serve the peasants as valuables to create asset and provide the farm families with security in times of crop failure serving as a convertible reserve for cash when needed (Gryseels and Anderson, 1983; Mesfin, 1991). But on the other hand, the activity of livestock production is being threatened due to the effect of rising population density and change in land use. Accordingly, it is common among peasant farmers currently practicing mixed agriculture, to see them use weakened and stunted plough animals specially in times of crop sowing when the grazings are exhausted and the stubble areas are cultivated.

The national problem of agricultural practices mentioned above is also the major prevailing situation among the peasant farmers of the study area, viz-Hitosa 'Wereda' of Arsi zone. As the researcher has observed, this problem manifested itself in several ways. Among these are (a) the rapid growth in the number of the rural household, (b) the decrease in average land holding sizes (c) the changes in types and patterns of major land uses, and (d) the changes in the needs for the use of modern farm inputs to improve the low level of production and productivity.

Therefore, the study attempts to evaluate the changing production practices and the changing needs in the use of modern crop production technologies of the peasant farmers under the situation of rapidly growing rural population.

1.2. Literature Review

1.2.1. Condition of agricultural development under population growth

The economic relationship that existed between population growth and increasing demand for additional food supply would lead to changes in the pattern of rural land use system of agricultural production practices to improve levels of productivity and production. Regarding this Boserup (1990) stated that the main condition in agrarian change is the growth of population density. In this respect much of her emphasis lie on the shift of agricultural technologies that can be expressed by the land use system, the cultivation method and the choice of tools. She also noted that rural societies have unrealized potential for further technological adaptation if and when population pressure begins to build up (1965) and added that sustainable agriculture can be realized not only in a single way (i.e. massive use of modern inputs) but in three different ways:-

> ..... There are three different ways to deal with the problems of soil fertility, weeds, water control and erosion: (1) fallowing-as in sparsely populated countries; (2)industrial inputs - as in high technology countries; and (3) labor intensive practices - as in densely populated countries at low technological levels (Boserup, 1990).

Boserup considered only one type of response i.e intensification of agriculture to match the increases in population pressure on agricultural land. However, in practice, people respond in different ways depending up on local circumstances and external situations (Bilsborrow, 1987; Dommen, 1988). Accordingly Bilsborrow has identified the following factors to explain multiple responses: (1) The existing standard of living; (2) the availability of untapped, potentially cultivable land ;(3) the availability of off-farm employment opportunities; (4) the existing cropping structure and its capacity for change; (5) institutional factors (e.g. existing land tenure system); and (6) the extent and effectiveness of state intervention. Market expansion is another important factor that determines patterns of response at a given time.

Rapid population growth under scarcity of capital and land may lead to scattered and fragmented farms. It would make crop rotation and agricultural innovations more difficult. Much land is used up for boundaries and circuitous irrigation and drainage channels...Litigation about the land increases wasting precious resources and often affecting out put adversely. Some of the land strips become too small to be worth cultivating especially if these are far from the residence of the peasants(Gray and Tangri, 1970). The reduced farm sizes unusually result in shift of production to subsistence crops and pressure peasants to lease the land of others and become share croppers(Tangri, 1970). He noted also that population growth may have contributed to the growing demand for use of modern inputs and the solutions to the problems of agricultural advance, but to promote the small rate of technical change in traditional agriculture the scarce resources are to be diverted from other economic sectors. And, Degene(1994) pointed that in land-resource environment facing rapid population growth and limited absorption by industry, raising out put per hectare might be the only way to raise labor productivity. In other words, at an initial stage of land scarce economics, increase in labour productivity is achieved by indirectly increases in yields.

Pingali and Binswanger (1985) stated that far from being immobile and technologically stagnant, traditional societies have responded to changes in population densities and external market with changes in farming systems and land use patterns, as well as technological changes in systematic and un-predictable pattern.

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Further more, population pressure influences the spread of cash cropping, change in methods of cultivation (including technology) such as adopting reduced fallow period, using compost, manure, fertilizers and irrigation, terracing, introduction of new crops etc. (Boserup, 1965; Gleave and White, 1969). Some crops give better yields than others and can support more population. Hence, population density influences the specific type of crop (s) cultivated in an area (Bekure, 1983).

Considering the relationship between population increase and changes in agricultural development, Schultz (1964) presented that if self sufficiency in food production has to be achieved, the productivity of the peasant farmer must be increased considerably and if this productivity is not promoted, it is not possible to attain improvements in rural economy and living conditions and thereby improvement in development.

Finally, Degene(1994) presented his argument on the problem of the relation between population growth and agricultural development as follows :

> ...rapid population growth per se may not be a problem by itself; but what matters is a country's institutional and organizational capacity to make effective use of farmers based use of research and science generated research as was the case in Japan during its take-off period. If the level of population density had been the main culprit, China and not Ethiopia, would have depended heavily on food aid.

1.2.2. Farming Systems and Crop Production Practices of Ethiopian Peasants.

In agricultural production practices of Ethiopia, the land asset which is suitable for crop production is estimated at 14.8% of the country's total size, out of which only 47.3% is used. As such there is a vast potential area to expand the cultivated lands. Hence, population increase may not be a severe problem, rather the major problem is the small productivity of labor and low yield of crops(Dejene,1994; Mesfin, 1991; Desalegn, 1984; Woubshet, 1989; Green,1974) which are associated to the characteristics of the Ethiopian traditional peasant agriculture (under the assumption that the rural households have access to possess their own land).

Among the several factors that contributed to the low level of productivity and crop yield of the peasant farming practices are the fertility status of the soil which is deteriorating due to improper

land use practices, poor seedbed preparations, weeds, crop pests and very little use of improved farm inputs such as chemical fertilizers, improved seeds and the like(Desalegn, 1984; Fasil, 1980; Westphal, 1975; Samia and Wubishet, 1996). At present a small fraction , i.e. less than 1 % of the total cropped area is served with improved seed and irrigation while fertilizers and pesticides are applied only on 32.7% and 9.4% of the total cultivated area respectively (CSA, 1995). The reasons are mainly associated with the limited capacities of the peasant farmers to purchase enough amount and/or their being not affordable by the majority of the peasants due to their high costs.

The peasant farmers produce crops under mixed farming on small and scattered farm plots where more than 67% of the peasants operate on farm sizes that range from, 0.50ha to 5ha depending on the size of the members of the household (CSA, 1995).

The agricultural practice of Ethiopia is season dependent and is mainly natural rainfed where the members of the household are the major unit of production and consumption(Desalegn, 1991). Because the traditional agriculture is highly seasonal in pattern closely related to the time of rainfall availability and because labor employed is mainly family labor there occurs overlapping of additional labor requirement (peak times) in certain working periods(Desalegn, 1991; Gryseels and Anderson 1983; Cleave, 1974; Woubshet 1989). The use of modern agricultural machinery such as tractors and combiners is limited in certain specific areas where there are former influences of development of private large farms and recently influence of state farms. Almost all of the peasant farmers depend up on the use of draft animals mainly oxen for cultivation.

These above presented farming systems of crop production practices reflect the general agricultural practices of Ethiopian peasant farmers. However, there can be both spatial and temporal differences in such practices owing to the presence of some major variations in local natural and socioeconomic factors of different areas in particular.

1.3 Objectives Of The Study

1.3.1. General Objective

The general objective of this study is to evaluate the condition of crop production practices under the situation of the rapidly growing rural population and limited land resource. This means, changes in number of agricultural households, patterns of land uses and cropping, and the use of

modern crop production technologies of the peasant farmers. It also assesses the condition of the need to innovate and modernize the traditional practices in response to the rapidly growing population.

1.3.2 Specific Objectives

The specific objectives of the study are to:-

(a) examine the major changes in agricultural land uses and cropping patterns in response to the growing population under limited land resource.

(b) evaluate the relations between the use of modern farm machinery and inputs and the increasing population in different climatic conditions.

(c) examine the relations between the farm income capacities of the peasants to obtain the services and supply of modern farm machinery and inputs and the practicability of these services and inputs in view of their high price conditions.

(d) assess the merits and demerits of the acceptance of the use of modern farm inputs and machinery in relation to changes in land use and labor productivity of the traditional peasant farmers.

(e) suggest appropriate steps to correct the weaknesses and enhance the strong aspects of the peasant agricultural practices.

1.4. Working Hypotheses

(a) Changes in agricultural land uses and cropping patterns have direct relationships with population growth under limited land resources.

(b) There is significant variation in the use of modern farm machinery and inputs among the peasants of different climatic zones due to unfavourable relief, poor development of rural roads and conditions of the supply.

(c) Access to the required modern farm inputs and services at any time depends upon the farm income level of each peasant farmer and his level of awareness as regards the benefits.

(d) Land and labor productivity of the traditional crop producing farms have increased significantly due to the increased use of modern farm machinery and inputs.

(e) There is a positive relation between the growing need for the use of modern inputs and machinery and increase in farm population.

1.5. The Study Area

1.5.1 Location and general physical conditions of the area

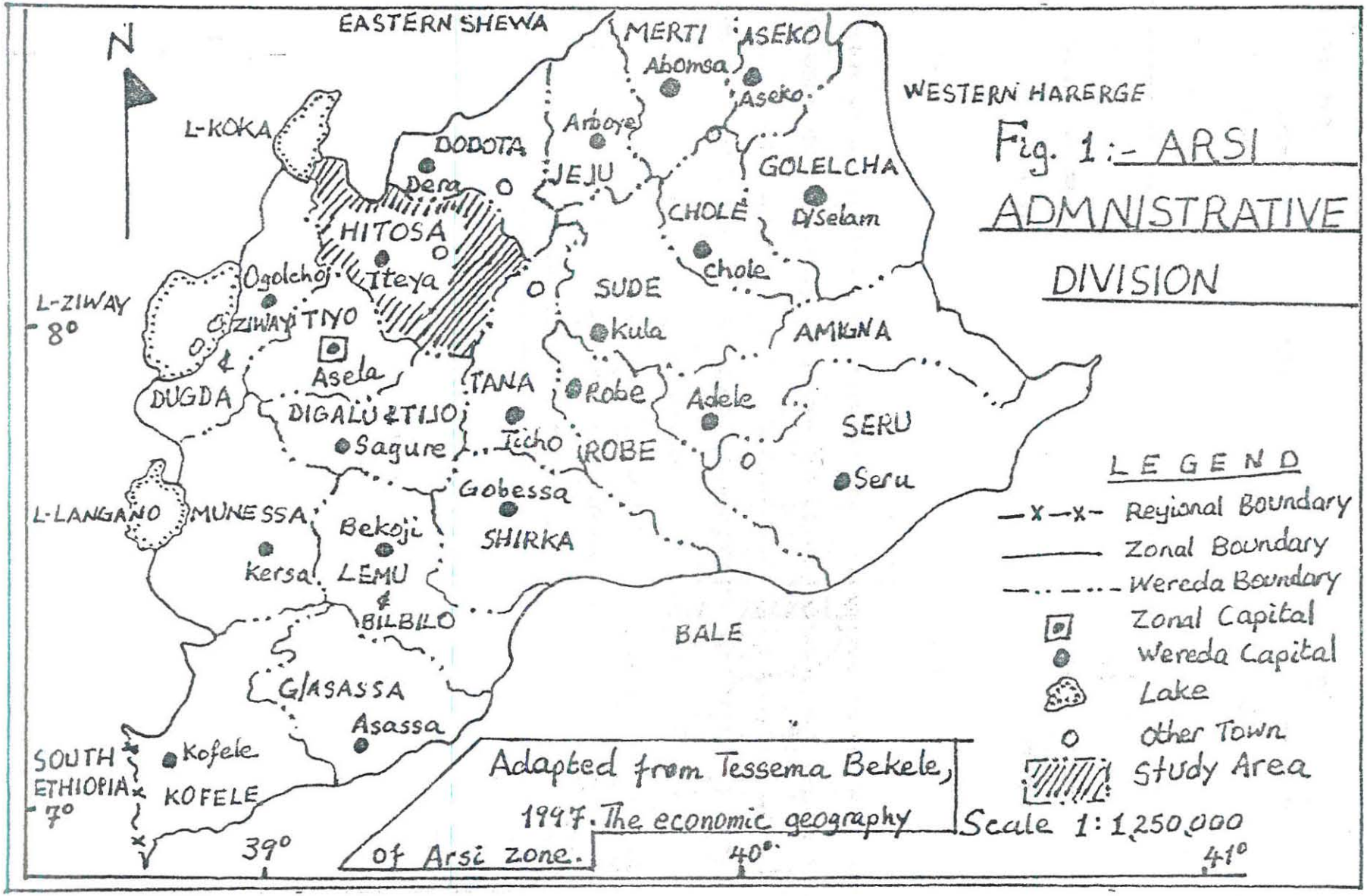
Hitosa 'Wereda' is one of the twenty two 'Weredas' of Arsi zone. It is situated in the central part of Ethiopia and the Oromia region and occupies the northern part of Arsi zone. This 'wereda' is located in between 7^0 50'N. and 8^0 20'N. latitudes and 39 03'E and 39^0 33'E longitudes approximately. It stretches over a total area of about 1553 square kilometers.

The 'wereda's' capital is Iteya town and is found approximately at a distance of 150 km south of Addis Ababa along the major road that runs from Addis to Bale zone through Assela, the capital of Arsi zone. Hitosa 'wereda' is situated between Dodota in the North east, Tena in the South east, Digalu and Tijo in the South, the Tiyo in the South west and Ziway Dugda in the West, and the East Shewa zone in the North west directions (fig.1 below).

Except for a small proportion of its northern,north-western and a part of its western sections that lie along the fringe and escarpment of the great Rift Valley, the major part of the 'wereda' occupyies the foot hills and western slopes of the Chilalo mountain . The general relief of the 'wereda' consists of relatively low land surfaces and high land areas. Its largest area lies with in average altitude of 1500 and 3500 meters above sea level . With in the 'wereda', average elevation increases from its western and north western to its eastern and south eastern directions (fig 2 below). Therefore, as a result of its relief the 'Woreda' experiences the major climatic characteristics of the 'Dega' over its most areas of the higher elevation of the eastern and south eastern directions, the 'Weina Dega' over the largest areas of the central parts and the 'Kola' over the western and north western parts.

The 'Dega' extends from 2400 to 3500m, the 'Weina Dega' from 1800 to 2400m and the 'Kola' below 1800m. A.S.L. within the 'Wereda'.

The mean annual temperature amounts range from 20 °C to 27 °C over most areas of the 'Kola' and higher 'Weina Dega' it ranges from 15 °C to 10 °C. April and May are the hottest months while December and January are the coldest months of the study area.


EASTERN SHEWA
MERTI
ASEKO
Abomsa
Aseko
WESTERN HARERGE
L-KOKA
DODOTA
Dera
Arboye
JEJU
GOLELCHA
D/Selam
CHOLE
Chole
HITOSA
Itteya
Ogolcho
SUDE
Kula
L-ZIWAY
8°
ZIWAY TYO
AMIGNA
Asela
DUGDA
TANA
Robe
Adele
DIGALU & TIJO
Sagure
Ticho
ROBE
SERU
Seru
Gobessa
L-LANGANO
MUNESSA
Bekoji
SHIRKA
Kersa
LEMU
BILBILO
BALE
G/ASASSA
Asassa
SOUTH ETHIOPIA
7°
Kofele
KOFELE
39°
40°
41°
Fig. 1:- ARSI ADMNISTRATIVE DIVISION
LEGEND
Regional Boundary
Zonal Boundary
Wereda Boundary
Zonal Capital
Wereda Capital
Lake
Other Town
Study Area
Adapted from Tessema Bekele, 1997. The economic geography of Arsi zone.
Scale 1:1,250,000

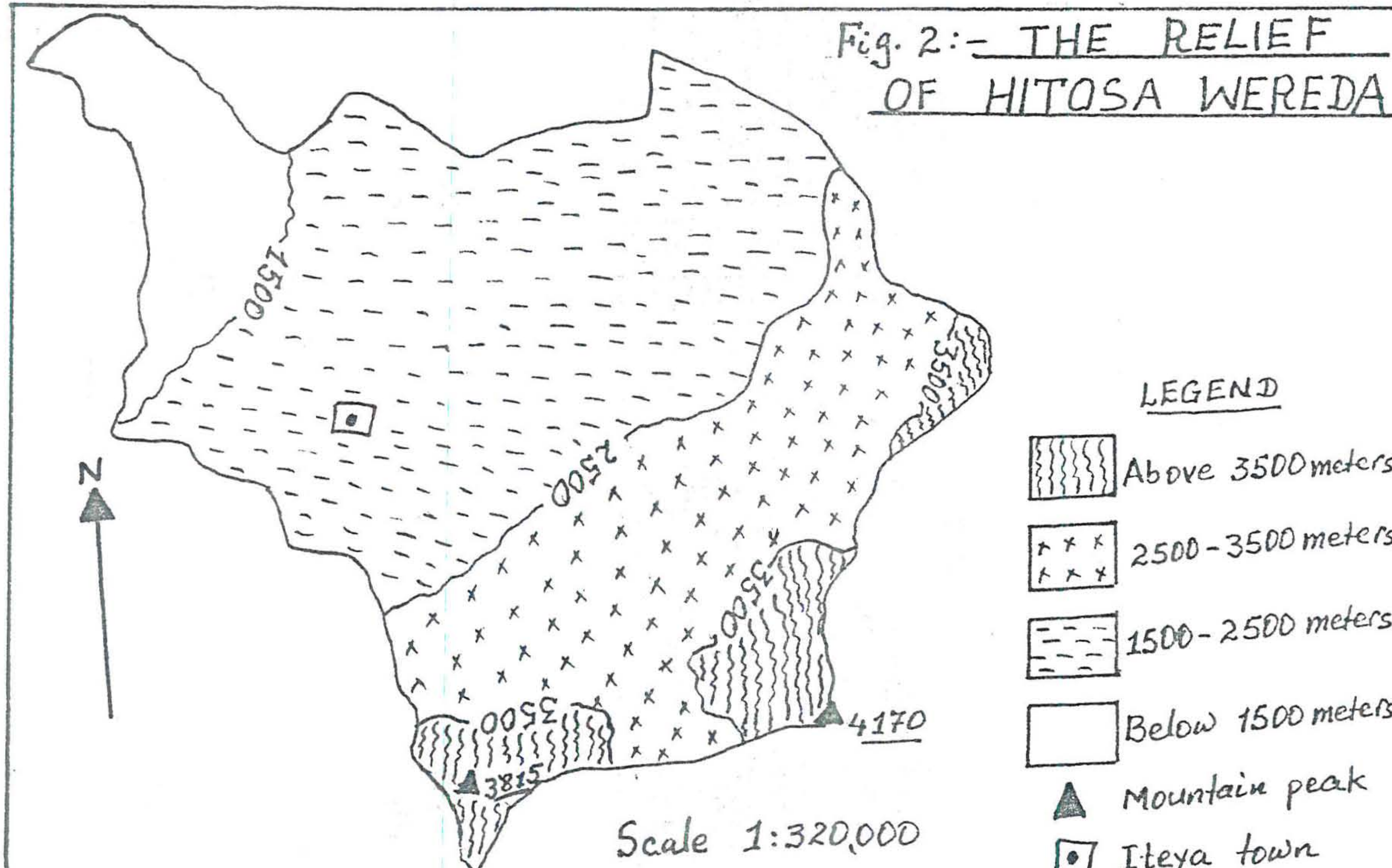


Fig. 2:- THE RELIEF OF HITOSA WEREDA

Adapted from Tessema Bekele, 1997. The economic geography of Arsi zone

In Hitosa 'Wereda' rainy season starts in March and extends upto October with highest rain concentration in June, July and August. The number of rainy days ranges from 145 to 200 over the higher parts ('Dega' and higher 'Weina Dega') but decreases to the lower parts of the 'Wereda'. The mean monthly amount of rainfall of the 'Wereda' is about 84.5 mm. and the annual mean is about 1008.6mm. Intensity of the rainfall is highest over the 'Dega' areas and decreases towards the 'Kola' parts but the variability is highest over the 'Kola' and decreases towards the 'Dega'. In the study area dry season extends from September to February months in general.

Thus, the 'Wereda' possesses varied climatic characteristics which range from cold and wet highland to warm and dry lowland. As a result of its climate, this 'Wereda' possesses natural environment which is conducive for the growth of different crops and vegetation.

A large part of the 'Dega' and 'Weina Dega' lies within the Awash drainage basin while a small part mainly the 'Kola' area and a few sections of the 'Weina Dega' fall within the Rift Valley lakes basin viz. Lake Ziway. There are no big rivers that drain the 'Wereda'. Rather a few small streams flow towards the Awash river from the higher slopes of the Chilalo mountain particularly over the 'Dega' section. Therefore, most areas of the 'Weina Dega' and 'Kola' parts stretch over flat or plain areas while the surfaces of the 'Dega' are relatively cut by these small rivers.

Except a small area along the eastern fringes, dense cover of natural vegetation is not found over the rest parts of the 'Wereda'. However, the most commonly seen types of natural vegetation are open and scattered vegetation types mainly dominated by acacia trees over the 'Kola' parts and high land vegetations mainly consisting of podocarpus trees over the 'Dega' areas. Besides these exotic trees namely the eucalyptus is commonly found in most settlement areas.

The 'Wereda' has soils that are largely developed over volcanic rocks. It has such soils like luvisols over the highland parts and andosols over the lowland areas which are good and suitable for agriculture (Tessema, 1997).

1.5.2. The general socio-economic aspects of the area

The 'Wereda's' total population was estimated at about 98,346 in the national census of 1984 of which about 92 % were rural people (CSA, 1988) . But according to the national census of 1994*

* The population figure of 1994 included the added people of about three PAs that came to the Wereda from its neighboring Weredas due to the restructuring program held after the census of 1984.

it was estimated at 174,360 of which about 88% were rural and 50.2% of the rural people were male(CSA, 1996). With a density of 98.8 persons per square km, this 'Wereda' is one of the eight 'Weredas' with high population density over the zone's average which is 93.6 persons per square km. (Tessema, 1997).

The rural dwellers of this 'Wereda' have a total of 28,869 peasant HHs that have an average family size of 5.31. These peasant HHs were organized under 89 PAs. But because of the restructuring program of 1997 these peasant HHs are reorganized under a total of 37 PAs. Out of this total, about 32.4 % reside in the 'Dega', 48.7% in the 'Weina Dega' and about 18.9% in the 'Kola' zones (Table 1 in chapter 2).

More than 90% of the peasant HHs practice mixed farming with emphasis on production of major food crops mainly wheat, barley, maize and teff. According to the information obtained from the 'Weredas' office of agricultural development, finance, and personally surveyed, the land holding size of the peasant HHs ranges from 0.5 to 3.5 ha. and the overall total average is about 1.51 ha.. Most of the holdings are small in size and fragmented. The activities of crop production are totally performed privately. The rural settlements are found scattered except a few which are seen in their formerly settled areas of settlement program of the past socialist system.

The largest proportion i.e. slightly more than 96 % of the rural people belong to the nationality group of the Oromo, and the remaining (about 4%) belong to the Amahara which are mainly found in the 'Dega' and 'Weina Dega' climatic zones. Most of the rural people follow the muslim and Ethiopian Orthodox religions, while a few follow protestant religion.

Because of the rapidly growing population size and the gradual decreasing changes in average land holding sizes of the individual households and the additional requirements of food supply every peasant farmer is struggling to improve his low levels of production and productivity. Therefore, the need and demand for the use of modern farm machinery and inputs of each peasant HH is growing although there is variation among the peasants. Besides this, the presence of various agricultural institutions, namely, ESSE, IAR, rural development projects such as CADU, ARDU and Ethio-Italian Rural Development Project (recently) and wide spread extension services of the MOA have contributed a lot to the growing need of the peasant farmers' use of modern farm inputs. Because

these institutions assisted the peasant farmers to be aware of the benefits that can be obtained from the use of modern farm in puts in promoting their low productivity levels. Thus, Hitosa 'Wereda' is one of the top chemical fertilizer consumer 'Weredas' of the Arsi zone. Regardless of the major problems associated with the economic reasons of the peasants and their small and fragmented farm plots, the uses and services of modern farm inputs and machinery are spreading widely as evidenced by the growing numbers of tractors, combiners and amounts of modern inputs (personal observation and information obtained from the office of agricultural development).used.

1.6. Justification of The study

The selection of this research problem and the study area is based on various major reasons. One of these is the accessible physical location of the 'Wereda' and the researcher's strong familiarity to the socio-cultural environments of that society which would help him to easily reach, communicate and obtain any relevant information.

In addition to this, Hitosa 'Wereda' is one of the principal crop producing areas in the region as well as in the country. This is so because of its conducive natural environment, agricultural resources, intensive farming practices which is assisted by improved use of modern inputs , and relatively developed rural infrastructure. But currently, the 'Wereda' experiences a growing population density that could create a growing pressure on the use of the available agricultural resources. In this 'Wereda',several private investors demonstrate a growing interest to invest their capital on modern farm machinery and modern farm inputs. There is also increasing interests of various governmental and non-governmental agencies such as the MOA, SG-2000, OSHO, CBE, ESSE, IAR, and Ethio-Italian Rural Development Cooperation to assist the peasant farmers both technically and financially in order to improve the peasants low level of production and productivity.

Therefore, it is for the major reasons presented above and some other favorable minor situations which have prominent significance to the crop production practices of the peasant farmers that have initiated the researcher to select this research topic and study area.

CHAPTER TWO
METHODOLOGY

2.1. Data sources and methods of collection

All the data employed in the study are both primary and secondary types. However, primary data form the base of most information used and conclusions reached.

The primary data are acquired and collected from the target sample population, viz, samples of peasant HHs, community leaders, PA leaders, and elders through questionnaire and interview. A few of the primary information are obtained from the physical environment mainly through observation and field surveys. Some primary information are also obtained from the officials of the 'Wereda' Agricultural Development and Finance offices by interviewing.

The secondary data are obtained from topographic and land use maps, various reports and documents of the Agricultural Development and Finance offices of the 'Wereda', the CSA, CADU, ARDU and Arsi zonal office of economic planning and cooperation, These data are collected through analyzing and interpreting the base maps, several reports and documents of the offices.

2.2. Sampling techniques and identification of sample units

2.2.1. Sampling techniques

The sample bases of this study are the PAs, the peasant HHs, the community leaders and elders, and the leaders of the PAs. Therefore, samples are selected randomly from each of these units as follows:-

(a) 30% of the total number of the PAs in the 'Wereda' are selected randomly by taking into consideration their proportionate distribution among the respective three climatic zones.

(b) From the sample PAs of the respective climatic zones, 5% of their respective total peasant HHs are taken as samples. However, the distribution of the sample HHs is based on the proportion and stratification followed by a random selection of the target sample units from groups of HHs with land holding sizes of less or equal to 1.00, 1.01 to 2.00, 2.01 to 3.00 and 3.01 to 4.00 ha. (Table 2 below).

(c) From the sample Pas, two sample community leaders and elders, and two PA leaders are taken by systematic random selection and are considered in the randomly selected sample HHs.

Hitosa 'Wereda' comprises of 37 PAs that has a total rural population of 153200 out of which 50.2% are male and 49.8% are female (CSA, 1996) (Table 1 below). According to the national census of 1994', this 'Wereda' has 28,869 peasant HHs that have an average family size of 5.31 members. As the information obtained from the 'Wereda's' office of MOA indicates, the 'Dega' climatic zone has 12 PAs that consist of 41.9% of the rural population and 41.4% of the total peasant Hhs. From the total population of the 'Dega' 49.9% are male and 50.1% are female. The 'Weina Dega' climatic zone has 18 PAs which holds 44.3% of the total rural population out of which 50.4% are male. This zone consists of 44.6% of the 'Wereda's total number of peasant HHs. The 'Kola' comprises of 18.9% of the PAs which holds 13.8% of the rural population, and 14% of the total HHs number. Among the total population of the 'kola' zone, 50.2% are male and 49.8% are female (Table 1 below).

Therefore, it is from these PAs and HHs that the sample units are randomly selected on the basis of their proportionate distribution and sizes of land holdings as presented above. **The number of the sample PAs taken is 30% of the total number of the PAs of the respective climatic zones. While the number of sample HHs is 5% of the total number of the HHs of their respective sample PAs .** This distribution of sample PAs and of the sample HHs that are randomly selected is shown in table 2 below.

This study evaluates the changes in crop production practices of peasant farmers on the basis of the observed production performances of the peasants by the selected sample years of 1977/78, 1987/99 and 1997/98. The researcher selected these years as sample periods only for his purpose of conducting historical analyses in the changes expected. Therefore, he would like to priorly inform that there is no other reasons for his selection of the sample study years presented here above.

Table 1:- Distribution of PAs, HHs and their family sizes and HHs in sample PAs

	' Dega'		' Weina Dega'		'Kola'		All zones	
	No.	%	No.	%	No.	%	No.	%
PAs	12	32.4	18	48.7	7	18.9	37	100.0
Peasant HHs	11951	41.4	12877	44.6	4041	14.0	28869	100.0
Population size	64177	41.9	67843	44.3	21180	13.8	153200	100.0
Av. family size/HH	5.37		5.27		5.24		5.31	
Holding sizes (ha.)	Peasant HHs in sample PAs by their holdings							
< 1.00	1179		898		201		2248	
1.01 to 2.00	1505		1785		548		3838	
2.01 to 3.00	310		1498		199		2007	
3.01 to 4.00	97		109		-		216	
Total	3091	37.1	4290	51.5	948	11.4	8329	100.0

Source: CSA, 1996; Offices of Hitosa 'Wereda' Agricultural Development and Finance.

Table 2:- Distribution of sample PAs and sample HHs.

			'Dega'		'Weina Dega'		'Kola'		All zones	
Sample units			No.	%	No	%	No.	%	No.	%
Sample PAs			4	36.4	5	45.5	2	18.2	11	100.0
Sample HHs by size of holding	≤ 1.00 ha.		59		46		10		115	27.5
	1.01 to 2.00 ha.		76		90		29		195	46.5
	2.01 to 3.00 ha.		14		75		9		98	23.4
	3.01 to 4.00 ha.		5		6		-		11	2.6
	Total no. Of sample HHs	M	133		182		42		357	85.2
		F	21		35		6		62	14.8
		M+F	154	36.7	217	51.8	48	11.5	419	100.0

Source:- CSA, 1996; Offices of Hitosa 'Wereda' Agricultural development and Finance.

Regarding the distribution of sample PAs out of their total number, 4 of them or 36.4% are selected from the 'Dega', 5 or 45.5% are from the 'Weina Dega' and the remaining 2 or 18.2% are from the 'Kola' climatic zones. On the other hand, the number of selected sample HHs that are taken from the 'Dega', 'Weina Dega' and 'Kola' climatic zones account for 36.7%, 51.8% and 11.5% of the total number of sample HHs (Table 2 above).

2.2.2. Identification of sample units

2.2.2.1. Age and sex structures of the sample HHs

The age structure of the sample HHs is summerized and presented on fig. 3 and appendix 1 .

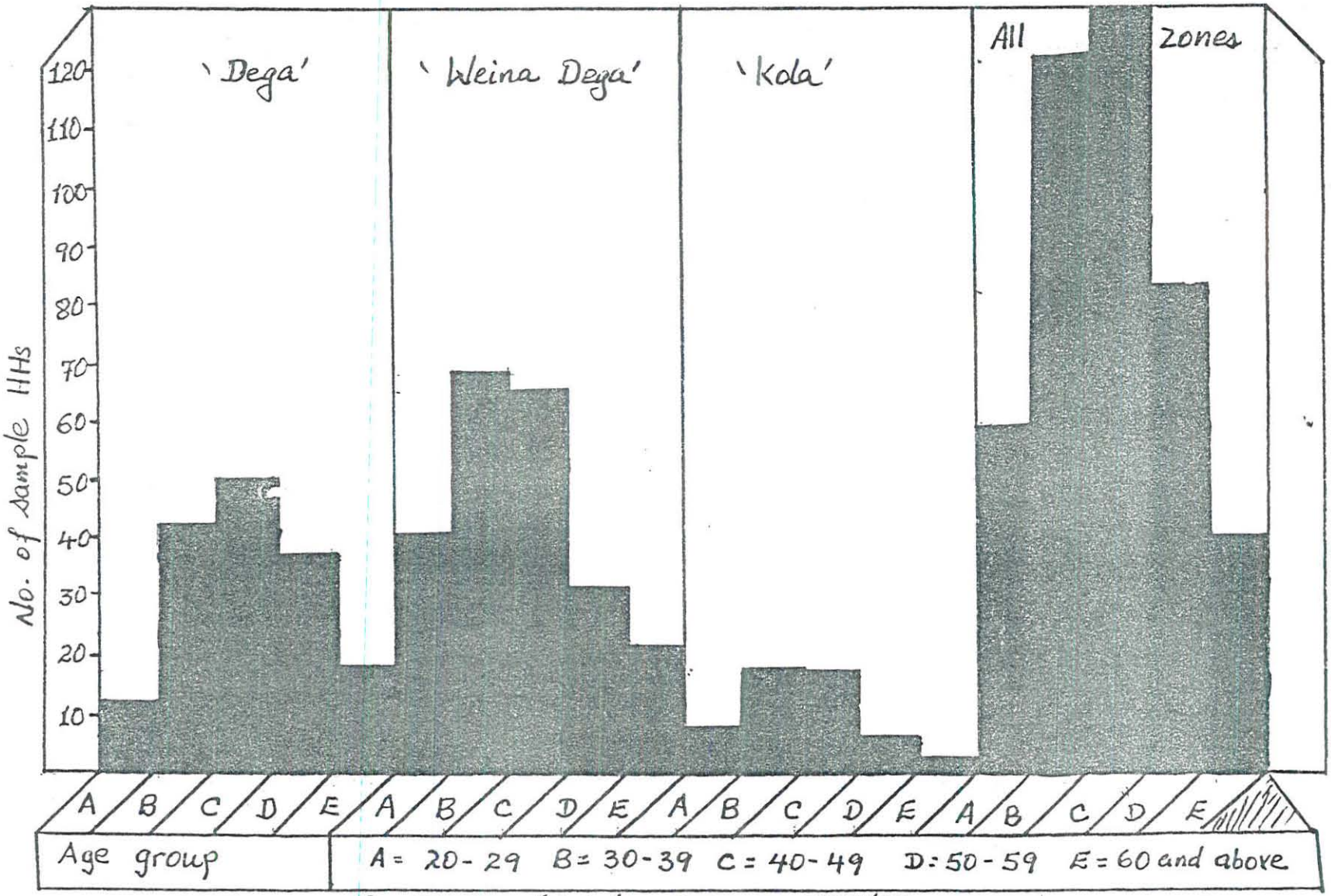
Among the 419 sample HHs, about 90.4% are aged less than 60 years. This age structure is variant among the sample HHs of different zones of the 'Wereda'. The percentage share of the sample HHs with age levels of less than 50 years is 65.5% for the sample PAs of the 'Dega' climatic zone while it is 76.9% and 83.3% for the respective sample PAs of the 'Weina Dega' and 'Kola' zones. Therefore, sample peasant HHs with relatively younger ages are more concentrated in the 'Kola' and decrease in number towards the 'Dega' climatic zones (Fig 3 below).

The male sample HHs are 357 and account for about 85.2% of the total, while female are only 62 and account for about 14.8% (Table 2 above). The largest proportion of the sample HHs is accounted for the male holders.

2.2.2.2. Martial status and family sizes of the sample HHs

According to the sample survey, out of the 419 sample HHs 346 of them are married, 30 are not married and 43 are divorced; and these groups accounted for about 82.6%, 7.2% and 10.2% of the total sample size respectively. Among the total male HHs 88.8% are married, 7% are not married and 4.2% are divorced, whereas, from the total female samples, the married, not married and the divorced groups account for 46.8%, 8% and 45.2% respectively. (Table 3 below).

Fig. 3:- Age structure of the sample HHs.



Source :- Sample survey, 1997/98

Table 3: Martial status of sample HHs

Marital status	Married		Not married		Divorced		Total	
Sex	No.	%	No.	%	No.	%	No.	%
Male	317	88.8	25	7.0	15	4.2	357	100.0
Female	29	46.8	5	8.0	28	45.2	62	100.0
Male + Female	346	82.6	30	7.2	43	10.2	419	100.0

Source:- Sample survey, 1997/98

The total number of family members of the sample HHs are closely associated to the total number of the HHs. The sample HHs have a total of 2212 family members and the average family size of a sample HH is 5.28 (table 4 below).

Table 4:- Family sizes of the sample HHs

Year		'Dega'	'Weina Dega'	'Kola'	All zones
1977/78	Number of sample HHs	89	112	28	229
	Total No. Of the family	397	486	119	1002
	Average family size of a sample HH	4.46	4.34	4.25	4.38
1987/88	Number of sample HHs	125	160	42	327
	Total No. Of the family	605	765	186	1556
	Average family size of a sample HH	4.84	4.78	4.43	4.76
1997/98	Number of sample HHs	154	217	48	419
	Total No. Of the family	827	1136	249	2212
	Average family size of a sample HH	5.37	5.23	5.19	5.28

Source: Sample survey, 1997/98

As a result of the growth in rural population, there is a corresponding increase in the number of HHs and their average family members. For instance, the number of sample HHs that have been engaged in farming activity till 1977/78 was 229 but ten years later it was 327 and by 1997/98 it grew to 419. Similarly, the corresponding average family sizes of each sample HH has grown from 4.38 in 1977/78 to 4.76 in 1987/88, and reached 5.28 in 1997/98. However, the overall distribution pattern of the family members among each of the climatic zones reflect similarity to the distribution of the total population.

2.2.2.3. The literacy status of the sample HHs

The literacy status of the sample HHs can be broadly classified in to two. These are the illiterate group which refers to those who are unable to read and write, while the second group is the literate HHs which refers to those who are able to read and write and at least perform or attempt the four basic simple calculations and have more than this educational status. This second group comprises of three major levels, namely the first level, which refers to those who have attended basic education standards of up to grade six; the second level refers to those who have educational standards of up to grade 7 or 8 and the third level refers to those who have educational standards of up to grades 9 and above.

As reported by the sample HHs, about 60.9% of them are literate but with different literacy levels and the remaining 39.1% are illiterate. (Table 5 below). Out of the literate HHs about 58.8% of them have only basic educational standards, i.e. up to grade six, about 29% of them have educational standards of up to grades seven or eight and about 21.2% of them have educational standards of up to grades nine or above.

2.3. Methods of Data analyses

a) Different tables, charts and graphs are used to organize and summarize the various data collected. Statistical measures such as the mean, range, standard deviation, variance, and percentiles are employed at the various steps to analyses and interprete the collected sample data.

b) Product moment correlation analysis is used to evaluate the strength of the relationship between change in:

Table 5:- Literacy status of the sample HHs

Literacy status	Literacy levels	Sample HHs	'Dega'	'Weina Dega'	'Kola'	All zones
Literate	First level literacy	Number	48	87	15	150
		%	31.2	40.1	31.2	35.2
	Second level literacy	Number	19	24	8	51
		%	12.3	11.1	16.7	12.2
	Third level literacy	Number	14	32	8	54
		%	9.1	14.7	16.7	12.9
	All literates	Number	81	143	31	255
		%	52.6	65.9	64.6	60.9
Illiterate	Illiterate	Number	73	74	17	164
		%	47.4	34.1	35.4	39.1
Total		Number	154	217	48	419
		%	100.0	100.0	100.0	100.0

Source:- Sample survey, 1997/98

1. Farm HH numbers and sizes of land holdings, in farm HH numbers and sizes of different types of crop farms (hypothesis 1.4a).
2. Access to required modern farm inputs and services, and farm income levels of the peasant farmers (hypothesis 1.4c) and,
3. Need to the use of modern inputs and machinery, and increases in HH number of farm population (hypothesis 1.4e).

c) Multiple and partial correlation analyses are used to evaluate the strength of changing relationships between land productivity of the traditional crop producing farms and increased use of modern machinery and inputs (hypothesis 1.4d).

d) Analysis of variance is used to analyse the significance of variation in the use of modern farm machinery and inputs among the peasants of different climatic zones (hypothesis 1.4b).

animals. Limited areas of grazing land will also create increased animal density which would result in problems of overgrazing, soil erosion, etc..

All the afore mentioned problems are prominent and common in almost all farm households of the study area while the responding mechanisms to each of these problems differ in accordance to the differing situations of their local environments and the intensity of each problem.

CHAPTER 4

FARM LABOUR AND FARM TOOLS UTILIZATION

Crop production practice in the study area is undertaken in two seasons which are locally known as the 'Meher' and 'Belg', a similar practice over most areas of Ethiopia. The main production season is the 'Meher' which uses the summer rains of June, July and August. The farm activities extend from March/April (the beginning periods of farm land preparations) to the months of November/January (the finishing period of crop harvesting) although there can be a little local variations from one climatic zone to the other. More than 95% of the total volumes of crops produced every year is produced during this main season - the 'Meher'. 'Belg' is a short season in which crop production is undertaken by the use of short rains that usually occur between the months of March and May of the year. Generally, over all areas of this 'Wereda' the crop production practice is dependent upon seasons of available and reliable natural rainfalls and all of the farmers practice natural rain fed agricultural production.

4.1 Sources And Uses of Human And Animal Labour In Crop Production

4.1.1 Human Labour

In the traditional crop production practices of the peasant farmers the most important types of labour are both human and animal labour. The family of the rural HH is the major unit of labour of production and consumption. Paid or hired human labour is used by a few of the HHs and is not a significant element as family labour in the system of production. Because of this great dependency upon family labour, it seems that a HH with larger size of family members is assumed to be more favoured as more hands are valued.

According to the information of the sample HHs 60.9% of them depend upon their respective family labour only while 9.8% use hired labour and the remaining 29.3% use hired labour in addition to their family labour (table 8 below).

Table 8:- Major types of human labour employed by sample HHs for 1997/98.

Climatic zone	'Dega'		'Weina Dega'		'Kola'		All zones	
Type of human labour used	No.	%	No.	%	No.	%	No.	%
Family labour only	99	64.3	126	58.1	30	62.5	255	60.9
Hired labour only	22	14.3	17	7.8	2	4.2	41	9.8
Hired and family labour	33	21.4	74	34.1	16	33.3	123	29.3
Total	154	100.0	217	100.0	48	100.0	419	100.0

Source:- Sample survey, 1997/98

Each member of the HHs contributes his/her labour either directly or indirectly to the various activities of crop production. Division of labour in the HH family is mainly based upon the age and sex structures. Children in the lower age groups, usually less than ten years, are mainly employed in looking after animals and fetching of fuel resources. The younger members assist the HH by directly participating in every activities of production in accordance to their physical ability. They perform the activities of cultivation, weeding, harvesting, gathering, threshing and transporting. They perform also the activities of fetching water and fuel resources and construction activities such as fencing, building houses and crop storages, Even those school enrolled children participate in each activities of crop production during their off-school times specially during harvesting periods as it is an urgent working period.

The female members are mainly responsible for home activities such as cooking & preparing food, taking care of children, sanitation & health cares, fetching water and fuel works such as winnowing, weeding, gathering and threshing activities.

Due to the main reason that traditional agriculture is seasonal in character in a pattern closely related to the times of rainfall availability and because the labour employed is mainly family labour, there occurs peak times of labour requirements in certain periods of intensive workings. The period which comes immediately after the onsets of rains i.e. when farm land preparation and crop sowing takes place; and harvesting time are periods of great urgency in agriculture and also are busy periods. Therefore the times of increased labour requirement in crop production activities tend to be in the middle of the wet season for weeding and in the beginning of the dry season for harvesting. These seasons are peak working times that demand additional labour. In areas where intensive crop farming is practiced weeding and harvesting

activities are mainly performed by hand and so demand intensive and increased use of human labour so as to minimize crop losses that could be resulted from damage by weeds and lack of harvesting at the right time. It is for this reason that the peasant farmers employ hired labour and also lend hands to each other through the use of traditional means of mutual assistance such as the 'Debo' or 'Jigi', 'Wonfel' and 'Kadechisa' (local names of means of mutual assistance) or use modern means (combiners for harvesting and weedkiller chemicals for weed control) if they have better farm incomes.

Although the peasant farmers employ hired labour mainly for weeding and harvesting, this labour is also used to perform the activities of farm land preparation, crop sowing, gathering and threshing. Among the total sample HHs who employ hired labour about 82.9% of them hire for harvesting and about 71.9% for weeding activities. A few of the sample households use hired labour because of physical disability, their small family size, or their limited or low farm incomes to use modern farm machinery and for weedkiller chemicals, etc.

The peasant farmers are relatively less busy and spare some times during the times when farming starts upto the onsets of heavy summer rains usually upto the mid of June. In these times, they usually go to farms in late hours (on average at 9:00 AM) and return home sooner (at about 3:00 PM) of the working days.

It is during and after crop sowing periods that the farm labours stay for longer working hours. Immediately when sowing activities begin (i.e starting from the mid-June to the end of July) every farm labour would be engaged in farm workings early in the morning (starting from 1.30 AM) and is busy working upto late after noon hours (upto 6.00 PM, if the farm oxen are strong enough). The same is true also for weeding periods specially in August month. In such times any farm worker including the hired one, spends more than eleven hours of each working days in the farms. However, the female relatively go to farms later and return home sooner than the male as the female members have additional works to accomplish at home.

The other urgent working time is the period of harvesting. In such time, since the male is the principal element, he starts harvesting earlier than 6.00 AM. Then he continues working upto late hours, commonly upto 7.00 PM and/or more in conditions of available moon light. During harvesting, any farm labour does not go home even for food or any purpose as he is supplied by others due to the urgency of the work. The female and children of the family assist the males in gathering and collecting activities.

4.1.2 Animal Labour

The activity of crop production practice of the peasant farmers of Hitosa 'Wereda' as a whole is performed under mixed farming - which is closely related to the activity of animal raising. This is mainly due to the reason that animals serve as the most important and significant sources of draft power for the various activities of crop cultivation and transportation purposes. Besides these importances the animals provide the peasant farmers with supplementary food items such as meat, milk and milk products. Animals serve the peasant as additional source of farm income and also assist him as important forms of insurance in times of both crop failure and failures in the market prices of the crops, as payments for his different farm expenses and home purposes, etc. Therefore it is due to these significance that each of the rural household raises at least one or two or more types of farm animals though the numbers of the animals raised are different among the individual raisers of different climatic zones through different times.

The major types of farm animals that are kept by the crop producer sample HHs of the study area include cattle (oxen, cows, heifers, bulls and calves), sheep and goats; and equines (horses, mules, and donkeys) to be used for various purposes. The number of these farm animals raised by the sample holders are not similar among each of the raisers and also among each of the climatic zones for the three periods of 1977/78, 19787/88 and 1997/98. There are close relations between the changes in the number of the sample HHs and the amount of farm animals raised in these different times (as can be refereed to table 9 below).

The total number of cattle which had been kept by the sample HHs in 1977/78 were 2117, the sheep and goats were 806 and the equines were 708 heads. The respective average number of these different farm animals that belonged to each of the HH was 12.5, 5.48 and 4.88 heads respectively. By 1987/88 the total number of cattle heads became 2440, of the sheep and goats had grown to 827 and of the equines reached 849, but their averages per HH declined to 10.6 for cattle, 6.31 for sheep and goats, and 4.45 for the equines. By the year 1997/98 the total number of cattle has grown to 2973, of sheep and goats to 921 and of the equines to 1047. On the other hand, the average number of each of these farm animals per HH decreased and became 9.91 for cattle, 5.2 for sheep and goats, and 3.98 heads for equines. Therefore as the information presented indicate, within these three different periods the total number of the farm animals have grown in correspondence to the growing numbers of the raiser HHs. On the other hand the average number of each of these farm animal types per HH decreased.

Table 9:- Distribution of farm animals raised by sample HHs

Year		Cattle						Sheep & goats			Equines			
		Oxen	Cows	Heifers	Bulls	Calves	All cattle	Sheep	Goats	All sheep & goats	Horses	Mules	Donkeys	All equines
1977/78	Animal numbers	577	486	366	325	363	2117	647	159	806	255	18	435	708
	No. of raiser HHs	169	147	112	100	111	169	114	33	114	85	6	145	145
	Av. animal no./HH	3.41	3.31	3.26	3.25	3.27	12.5	5.68	4.82	7.1	3	3	3	4.88
	St. Dev.	1.51	1.35	1.30	1.09	1.32	1.31	3.39	2.70	7.07	-	-	-	-
	C.V. (%)	44.4	40.9	40.6	33.5	40.4	39.4	59.7	56.0	59.7	-	-	-	-
1987/88	Animal numbers	718	586	391	359	386	2440	648	179	827	273	3	573	849
	No. of raiser HHs	231	187	127	118	127	231	131	38	131	91	1	191	191
	Av. animal no./HH	3.11	3.13	3.08	3.04	3.06	10.6	4.95	4.71	6.31	3	3	3	4.45
	St. Dev.	0.72	0.82	0.61	0.45	0.23	0.65	3.06	2.87	3.01	-	-	-	-
	C.V. (%)	23.1	26.2	19.8	14.9	7.5	21.1	61.8	61.0	69.9	-	-	-	-
1997/98	Animal numbers	915	691	485	399	483	2973	731	190	921	249	9	789	1047
	No. of raiser HHs	300	222	160	133	161	300	177	45	177	83	3	263	263
	Av. animal no./HH	3.05	3.11	3.03	3	3	9.91	4.13	4.20	5.20	3	3	3	3.98
	St. Dev.	0.50	0.75	0.39	-	-	0.54	2.22	2.39	2.26	-	-	-	-
	C.V. (%)	16.4	24.2	12.9	-	-	17.7	53.8	56.9	54.4	-	-	-	-

Source:- Sample survey, 1997/98.

This changing pattern of the farm animals is similar among all of the three climatic zones of the study area but the only difference is in their respective absolute figures.

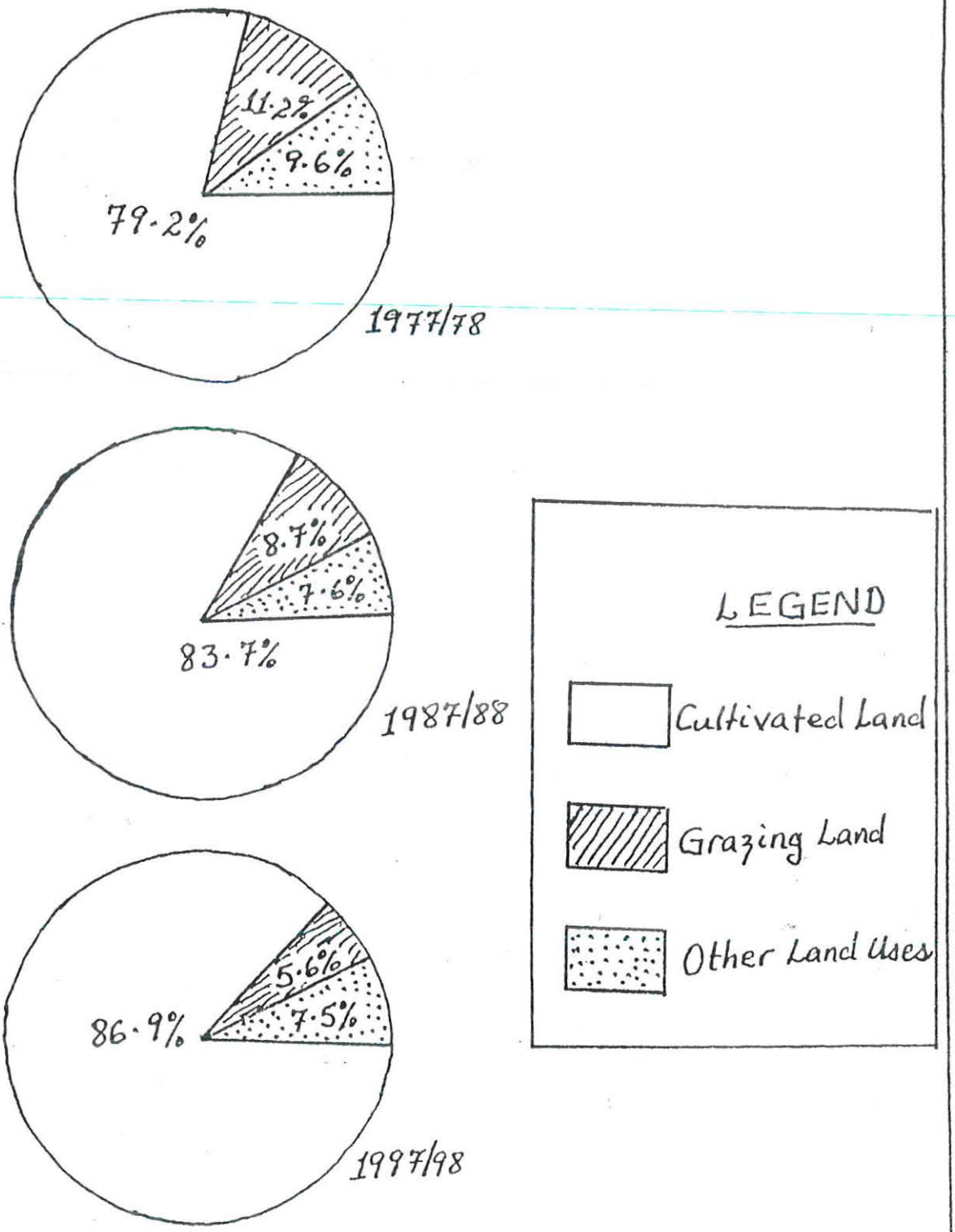
The changing pattern in the number of the farm animals has some notable association to the changing pattern of the major land use types, viz. the changes in grazing lands and cultivated lands in response to the changes in the number of the HHs. Accordingly the growing change in the total number of the farm animals has positive relation to the growing change of HHs number. In the contrast, the decreasing change in average possessions of these animals per HH has negative relation to the change in HHs number. The average farm animal possession of a HH and his total number of farm animals that he raises decreased as the average size of grazing lands became smaller and smaller. On the other hand, the total number of the farm animals which are raised by the sample HHs increased since some amount of farm animals are raised by the additional numbers of the raiser HHs. This is to say that population growth would result in decrease of grazing land uses that would lead to limit the total number of farm animal that a single HH could keep while growth in population number would result in growth in number of HHs and thereby growth in total number of farm animals since the added holders could keep some number of their own animals.

Although each of the farm animal type has its various valuable economic contributions to the living conditions of every raiser peasant HH, this topic mainly attempts to present the significance of the farm animals as sources of farm labour in the activities of crop production practices and the major problems encountered in this production practices in association to the labour supply of the farm animals. In this respect therefore, the types of farm animals which are major sources of draft power and are used most regularly by the peasant farmers of the study area are the oxen for crop farming activities and the donkeys for transport purposes. Each and everyone of the crop cultivator peasant of any climatic zone is strongly dependent upon the oxen and donkeys at any time. Hence, most of the sample HHs own at least one or more number of oxen and donkeys. For example, in 1977/78, 73.8% and 63.3% of the total farm animal raisers owned oxen and donkeys respectively. In 1987/88 these percentages were 70.6% and 58.4% of the total HHs owned oxen and donkeys respectively. In 1987/88 it was about 71.6% for oxen owners and 62.8% for the owners of donkey and rank first and second for each of these three years. Along side the decreasing trend of average numbers of oxen belonging to a possesser HH: the variations in distributions of the oxen among their owners become narrower and narrower as

indicated by the values of standard deviations and coefficients of variations. The standard deviation values for 1977/78, 1987/88 and 1997/98 are 1.51, 0.72 and 0.5 respectively while the respective coefficients of variation in average possessions of the oxen are 44.4%, 23.1% and 16.4% for these respective years. Accordingly any peasant farmer in the area has to possess a pair of oxen or more in order to perform his crop farming activities without being dependent upon his other fellow farmer. The oxen are the basic sources of animal labour and play a key role in all crop production performances of each peasant HH since the activities of cropland cultivation and threshing are done by the use of oxen. Similarly, donkeys are most important mainly for activities of transporting materials such as gathering of harvested crops, transporting crops from farm areas (fields) to storage locations, from storage points to market centers and also transport different required farm inputs and any other necessary farm materials from market places or elsewhere to the farm locations, etc... Generally, almost all of the transportation activities are mainly performed by the use of the equines and donkeys play the leading role in this part.

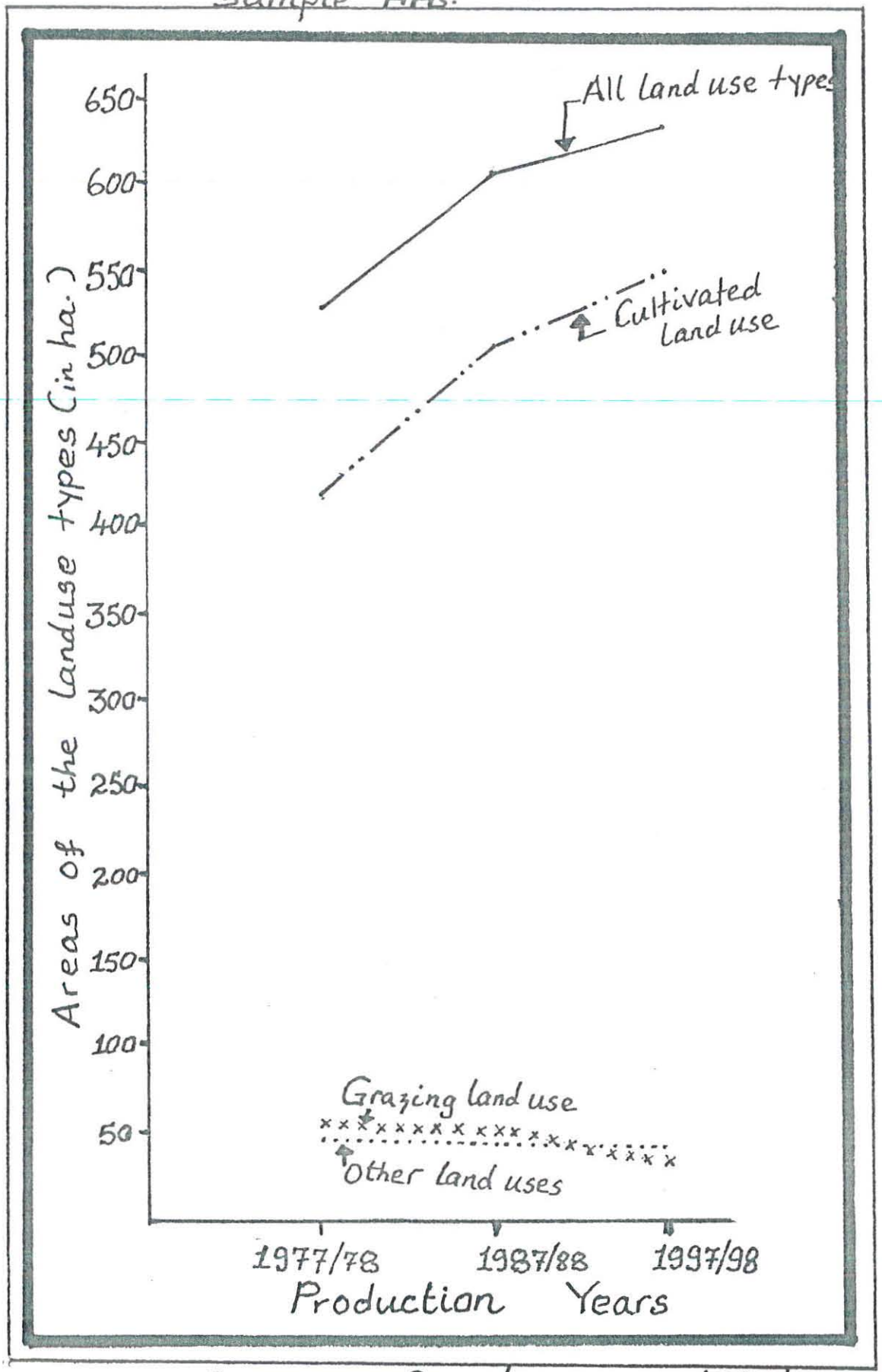
The major feed of these farm animals are the natural grazings (natural grass), hay, straw, stubble and in recent time produced fodder began to appear. However the degree of importance of these animal feed types differ from place to place and from time to time. As the information obtained from the sample survey indicates (table 10 below), most of the HHs of the 'Wereda' were mainly depending upon natural grazing to feed their farm animals until 1977/78 and the stubble was the second most important source of their animal feed was the stubble. But after 1987/88 this great dependency upon natural grazing lands began to decline and more dependency began to be shifted gradually to straw and stubble. Besides this, the activity of producing animal fodder as supplementary feed to natural grazing, straw and stubble started to be practiced by a few peasants of the 'Dega' and Weina Dega' climatic zones. Recently, specially after 1988/89 the largest proportion of the sample households were highly dependent upon the straw while great dependency upon natural grazing had become considerably weak. The number of sample holders that produce fodder have grown and is seen spread relatively wider among many peasant farmers of the 'Weina Dega' and 'Kola' zones.

Fig. 4:- Percentage distribution of the areas of major land use types of the sample HHs.



Source :- Sample survey, 1997/98

Fig. 5 :- Areas of the major landuses of the sample HHs.

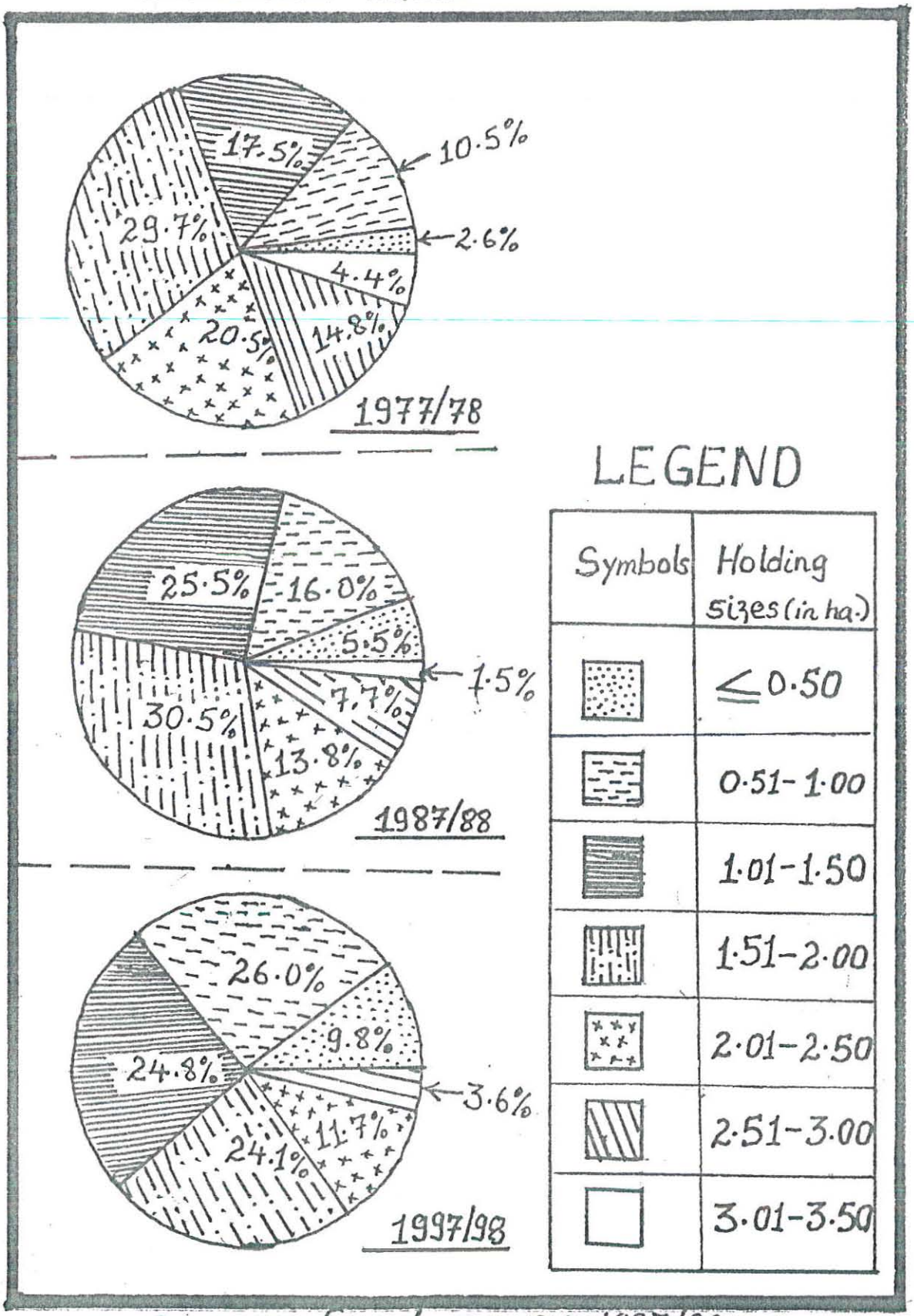


Source :- Sample survey, 1997/98

three years was 420.5, 507.0 and 550.25 ha. and have been held by 229, 325 and 419 sample holders respectively (app. 3). The average holding sizes of cultivated land of a sample holder for each of these respective years were, therefore, 1.84, 1.55, and 1.31 ha. Although the patterns of changes in average holding sizes of sample holders of different climatic zones for the 1977/78 to 1997/98 were similar, there is a lot of difference in average holding sizes of the holders of the 'Dega', 'Weina Dega' and 'Kola' climatic zones mainly due to their average family sizes and availability of land assets in their respective PAs. For example in 1977/78 the average holding size of cultivated land of a sample holder of the 'Dega', Weina Dega' and 'Kola' zones were 1.52, 2.10 and 1.80 ha. respectively while for the year 1987/88 it was 1.14, 1.91 and 1.42 ha. and for 1997/98 it was 0.99, 1.53 and 1.39 hectares for the respective climatic zones. Corresponding to such differences in average holding sizes, there are also variations in the proportions between the areas of cultivated land uses and the total areas of major land use types among different climatic zones within the study period. In 1977/78, land under permanent cultivation had accounted for about 76.5%, 79.9% and 84.2% of the respective total areas of major land use types of the 'Dega', Weina Dega' and 'Kola' climatic zones, whereas it was about 76.4%, 86.2% and 91.5% in 1987/88 and 77.6%, 90.5% and 93.7% in 1997/98 respectively.

The holding sizes of cultivated land uses of individual sample holders show also both temporal and geographic variations. For instance, in 1977/78 the sample holders that had cultivated land sizes of 0.01 to 0.50 ha. accounted for 2.6% of the total sample holders of this land use type while this proportion was 5.5% in 1987/88 and became 9.8% in 1997/98. (Fig.6 below). The sample holders who had cultivated land use sizes with areas that range from 0.51 to 1.00 ha. in 1977/78, 1987/88 and 1997/98, accounted for about 10.5%, 16.0% and 26.0% of the total sample holders of this land use type for the respective years. But on the other hand the proportions of the sample holders of this land use that are found in relatively larger holding sizes became smaller and smaller from 1977/78 to 1997/98 (Fig. 6). Generally, more than 60% of the total sample holders of 1977/78 had holding sizes of cultivated land use which are less than or equal to two hectares and grows to about 77.5% in 1987/88 and reach about 84.7% in 1997/98.

Fig. 6:- Percentage distribution of the sample HHs. by their holding sizes of cultivated lands.



Source:- Sample survey, 1997/98

The major change observed in cultivated land use therefore is that its total area has increased since 1977/78 and along side, its percentage share of the total areas of the holdings had grown rapidly. The general average size of a peasant's holding however decreased considerably though some differences both in amounts and rates of these changes are seen. The total size of cultivated land which was 420.5 ha. in 1977/78 increased to a total size of 550.25 ha. in 1997/98 and its percentage share had grown from 79.2% to 86.9% respectively. But in contrast to this condition the average holding size of a sample holder of this land use type had declined from 1.84 ha. in 1977/78 to a size of 1.31 ha. in 1997/98. These changes can be therefore associated with the growing changes of the total population mainly rural population due to the fact that additional people would demand in additional areas of crop cultivation so as to produce more and meet the growing demand for food requirement specially under such conditions where there is a slow rate of improvement in the crop production technologies. As this association can be observed from app.3, the proportions of the areas of cultivated land use to the total areas of other land use types have grown in response to the increased number of sample HHs due to the main reason that the added people (i.e both the increased number in HHs and members of their families) would demand additional food and also open field of job opportunity for the added people (since agriculture is the most significant occupation for the majority of the agricultural society) through expanding the cultivable lands. In addition to area expansion, there occurs also a gradually diminishing situation in the overall average size of cultivated land use that is available to a single holder specially under the situation of availability of additional arable land is limited and rapid growth in farm population size occurs. This changing situation therefore results in various changes in different conditions of the existing agricultural practices such as changes in types and patterns of major land uses, patterns of crop cultivation, uses of agricultural technologies etc.

One of the principal implications of population growth from the point of view of the changes in rural land use and additional demand for food supply is that more people means additional demand for cultivable land and increase in total production volume so as to meet the growing need of food requirement. This is basically because added number of people implies additional number of mouths to feed. Accordingly, population growth would necessarily lead the agricultural sector, mainly the activity of crop cultivation to raise its overall volume of crop production by

making efficient uses of the resources and all possible mechanisms that are available. Although there could be several means which are helpful to raise the volumes of crop production, one of the methods currently used by most of the peasant farmers is expanding areas of cultivation (as evidenced by the information presented in app. 3 and figure 4). Growth in the number of HHs have resulted in increased area of the total land used for cultivation purpose through its area expansion and thereby imposing significant decreasing changes on total areas of other major land use types. This expansion of cultivated land uses may indicate that increased use of arable land and rural labor through employing the existing production technology, is believed to increase the low volume of crop production. Of course additional use of land and labor could be one important means of raising production levels but besides this alternative the use of modern farm inputs have to be considered. (This use of modern inputs will be presented in chapters 4 and 5 of this paper).

Apart from the possible advantage that can be obtained from expanded cultivated land use, there are also several adverse effects of this situation upon the traditional crop production practices. As the information obtained through field observation and from the sample survey indicate, the changes in patterns and type of major land uses due to population growth, expansion of crop lands have resulted in various problems. The major ones include land fragmentation, low fertility status of soils, clearing of forest lands and accelerated soil erosion both by wind and water. These in turn limit the availability of natural grazing thereby creating the problem of feeding farm animals, land and soil degradation, problems in the use of modern farm machinery, rural migration, etc. Hence, all these problems impose directly or indirectly negative influences upon the total volume of crop produced and levels of productivity. To present the direct influence of limited availability of natural grazing land uses as an example, since most of the crop producer peasant farmers practice mixed farming, the decreasing change in areas of grazing land use would result in scarcity of natural grass and/or vegetation supply which are the major sources of animal feed in the sector. Therefore, the more area of grazing land uses decrease the more will draft animals, specially the oxen, suffer from food shortage and thereby the lesser they will be efficient enough in their capacity of supplying draft power to the activity of crop production. Shortages in grazing land uses also limit the amounts and qualities of the farm animals' and their products (such as meat, milk, etc..) which inturn negatively influence the farm incomes of the peasants and also the food obtainable from these

e) F-test and coefficient of determination are used to assess the significance of variations and to show the proportions between the dependent and independent variables for correlation analyses stated under 1.5.3b and 1.5.3c above.

f) Coefficient of specialization or crop diversification model is employed to describe the relations that exist between the crops grown and to determine which crops farmers are most likely to produce simultaneously (hypothesis 1.4a).

2.4. Organization And Presentation Methods

This study is mainly designed to examine and/or evaluate the major changes observed in the pattern of agricultural land uses, cropping paterns, production practices and farming systems of traditional agriculture under a situation of growing population and limited land resource. Therefore, the various analyses, assessments, evaluations made in this respect and conclusions reached by the study are presented by being organized in six major chapters that consist of different sub-topics.

The study paper contains a few pages of acknowledgements, definitions of abbreviations and terms, and lists of tables, figures, appendice and contents in its front parts. The contents of appendix and bibliography are also presented in a few of the last pages of the paper.

The first chapter of the paper introduces the problem of the study, the review of the related literature, the objectives, working hypotheses and justifications of the study and study area.

It is the second chapter which presents the briefings on the methodology parts of the study. Thus, chapter two explains the types and sources of the data/information employed the sample units used, and the sampling techniques and methods employed to acquire the required data/information to undertake the study. This part also presents the various quantitative and qualitative methods employed at different steps of analysing and evaluating the data/information used while conducting the study.

The land holding and land use survey including the examination made in the patterns and changes in the land uses of the study area are presented in chapter three. Chapter four is a part where the assessment on farm labour utilization in peasant agriculture is presented. Therefore, it deals with the sources and use of both human and animal labour, the types, sources, and uses of both traditional farm tools and modern farm machinery including their significance in traditional production practices. The major problems encountered the peasant farmers in their use of modern farm machinery are also referred in this chapter.

The analyses made on cropland uses, crop cultivation practices, and the uses and supplies of modern farm inputs (chemical fertilizers & selected seeds) of the peasant farmers in the study area are explained in chapter five. It is also in this chapter that the patterns of crop productions and productivities of the farmers, their need and access to the use of modern inputs are presented.

The major results obtained by testing the formulated hypotheses and conclusions reached are explained in chapter six. Finally, the paper winds up by presenting the summary of the study and some recommended points in the conclusion part.

The various information/data that are used in the steps of the study are mainly primary ones. Hence, different statistical measures, graphs, figures charts and maps are used to organize summarize, present, analyse and evaluate the various data used in the study. Generally, the evaluations and analyses made and conclusions reached are organized and presented through the use of different qualitative and quantitative methods.

The study is expected to make an assessment of available agricultural resources with the intention to identify the farming systems/practices of the traditional agriculture. It is also desired to evaluate patterns of agricultural productivity and factors that generate them. As such, the study may provide basic information/data needed to highlight the uses and misuses of available resources and hence, formulate and/or pursue sound polices to improve production by overcoming the constraints which adversely affect agricultural productivity in the area.

Although the resources of crop production consist of wide ranges of natural, socio-economic, demographic and institutional factors, this study is limited to cover a small parts of the socio-economic and demographic factors. Therefore, the researcher would like to state that much of the emphasis paid in the study lie on the relations of some factors of the socio-economic and demographic elements that may result some changes in the crop production practices of the peasant farmers.

As it is noted in page 15 above, the study covers the production performances of the peasant farmers in three different years found within the time ranges of 10 to 20 years. Because of this time gap some of the sample HHs were subject to provide estimated information while filling the questionnaire which is one of the major limitations of the study. In addition to this a few of the sample HHs gave either under estimated or exaggerated information which would have certain influence on the quality of the findings. The numbers of PAs of the Wereda before and after the restructuring program were different. However this had little contribution to the quality of the paper since the principal sources of information used are the sample HHs but not the sample PAs randomly selected.

CHAPTER THREE

POPULATION GROWTH, LAND HOLDING AND AGRICULTURAL LAND USE

3.1. Effect of Population Growth On Land Holding And Agricultural Land Use - Theoretical Back-ground

One of the principal consequence of population growth under conditions of limited land resource is a growing population density. This growing density has significant impact on rural development and has been a controversial issue. Many scholars have presented that rapid population increase has an obvious effect on the natural resources and agricultural environment (Markos, 1990; Wood, 1990; Daniel, 1990; Repetto and Thomas, 1983). Population density has its own effect on the general condition of agricultural practice. It results in more intensive land use and change in land use pattern. High population density leads to expansion of cultivated land and gradual diminution in land holding sizes (Boserup, 1965; Clarke, 1968; Grigg, 1966; Gleave and white, 1969; Morgan and Munton, 1971; Bennech, 1972). Growth in population density would result in land fragmentations and reductions in length of fallow periods (Boserup, 1965; Fasil, 1980; Repetto and Thomas, 1983; Getachew and Mekonen, 1984; Dejene, 1986; Desalegn, 1984).

As population density increases, grazing lands would be changed to cultivated lands which inturn would result in shortages in grazings (over grazings), overcrowding of animals and deterioration in livestock enterprise, decline in agricultural yield and income, increased engagement in off-farm activities, etc... (Boserup, 1965; Smeds, 1955; Shack, 1966; Dejene, 1986).

The general relation between population density and land productivity is noted to be positively correlated (Brookfield, 1984, 1972; Turner et. al., 1971; Boserup, 1965, 1981; Dayal, 1984) since high population density creates demand for agricultural products and agricultural land and gradually result in small holdings and labor intensive cultivation.

Therefore, this general effect of rapid growth change in population size and then density is one of the attributable factors to the problems of agriculture in most part of Ethiopia although its intensity may differ. According to information on current demographic changes of Ethiopia indicate, its population experiences a high and rapid average growth rate i.e about 3% per annum (CSA,

1996). As a result, therefore, the simple man-land ratio at national level increased from about 22 persons/km^2 in 1975/76 (CSA, 1977) to about 40.7 in 1990 (CSA, 1991) and reached about 48 persons/km^2 in 1994 (CSA, 1996). Thus, with changes in population number there is a corresponding change in sizes and patterns of land uses. The proportion of rural land to rural population shows negative relations to the growing demographic changes. This change in the ratio of rural land to rural population gradually imposes change in rural land use and holdings which would eventually result in demand for increased agricultural production i.e expansion in cultivated land use under a traditional production system where the use of modern farm inputs is limited.

This general population growth which is one of the major demographic characteristics of Ethiopia and its effects on holding sizes and land use patterns are also attributable factors to the people of the study area.

These effects of population growth are also evidenced by the information/data obtained from the sample HHs. According to their report 229 sample HHs or about 54.6% of their total were engaged in agricultural activity untill 1977/78. The sample HHs that engaged themselves in agricultural occupation from 1978/79 to 1987/88 were 98 (23.4%) while those who were engaged in this economic occupation from 1988/89 to 1997/98 were 92 (22%). Thus, the total number of sample HHs changed from 229 in 1977/78, to 327 in 1987/88 and 419 in 1997/98 and reflects the growth in the number of rural land holders as an outcome increases in the total population. This difference in the number of HHs indicate the newly engaged (added) peasants to the farming activity in different times as the members of the HHs' family are grown in age or other reasons related to in migration. Such new entries or members of PAs would be provided with land by their respective PAs before 1987/88 when there was land redistribution. But later, such members would own land either by inheriting from their parents and/or shared from their respective volunteer relatives.

In addition to this, there is a significant growth change in both the total and average rural family sizes as a consequence of increasing population. As it is indicated by the sample HHs, the total family size of the 229 HHs in 1977/78 was 1002 and the average was 4.38 members (Table 4 presented in chapter 2). In 1987/88, the 327 HHs had a total family size of 1556 and the average number was 4.76 members/HH. And in 1997/98 the 419 HHs had the respective total and average family members of 2212 and 5.28/HH.

3.2. Population and Changes In Land Holding 1977/78, 1987/88 and 1997/98.

The principal resource of human beings and that of an agrarian society in particular is land. Man is interacting with his natural environment including land in order to produce his basic necessities. Hence, land use is the end product and manifastation of the degree of interaction between land and his ecological conditions and a kind of permanent and cyclic intervention of man in his environment (Freeman, 1976). Therefore, the distribution, type and pattern of land use is thought to be an important indicator of the state of the resource base.... consequently, of the problems and of the possibilities of sustainable development (Solomon, 1992).

One of the notable factors of land holding and land use changes is the demographic condition. Because land holding and land use are the product of man's interaction with his natural environment, rapid population growth and then population pressure play influential role in these changes.

In Hitosa 'Wereda' population has been showing a rapid growth and so does increase in population pressure and/or changes in available per capita land including land holding sizes. As the sample survey indicated, the land size that had been under a total holding of 229 sample HHs in 1977/78 was 530.5 ha. and the average was 2.32 ha../HH (refer to app. 2). In this time, the HHs that had land holding sizes of less than two hectares accounted for about 38.9% of their total number. The households whose holding sizes were less than 3 ha. accounted for about 80.4% and those with less than 4 hectares accounted for about 93.5% of their total number. The maximum size of land holding of a sample HH in 1977/78 was 5 ha.

In 1987/88, the total size of the land held by the 327 sample HHs was 605.5 ha. and the average size was 1.85 ha../HH. The maximum size of holding of a HH in this year was 4 ha. The number of HHs who had holding sizes of less than two, and 3.00 ha. accounted for about 59.7% and 92.7% of the total sample HHs of the year respectively.

In 1997/98, the total land holding size of the 419 sample HHs reached 633.5 ha. and the average became 1.51 ha../HH. Sample HHs whose holding sizes were less than two hectares accounted for about 73.8% or almost three-fourth of their total number and those with holdings of less than three hectares accounted for about 97.4% (app. 2).

The major changes that one can observe in these three periods are that the total holdings of the sample HHs increased, while the sizes of average holdings decreased from 2.32 ha.in 1977/78

to 1.85 ha. in 1987/88 and to 1.51 ha. in 1997/98. Besides, there is a shift of holders from the group of larger holding sizes to the group of smaller holdings as the number of rural population grows. Hence, the distribution patterns of HHs in relation to the different holding sizes have varied significantly for these study periods.

Regarding the differences in average holding sizes of the sample HHs, deviations from the means decreased from 0.95 in 1977/78 to 0.80 in 1987/88 and to 0.79 ha.in 1997/98. However, the variations in average holding sizes of the holders revealed increasing changes as expressed by the C.V. of 41%, 43.2% and 52.3% for the respective years of 1977/78, 1987/88 and 1997/98.

In conclusion therefore, with increases in the number of HHs the total area of all the peasants' holdings increased while the average holding size decreased significantly. Besides this the proportion of HHs with smaller holding sizes increased while for those of larger holding sizes decreased. Then the effect of such condition would lead to various problems such as land fragmentation, population pressure related to increased rural density, deterioration of natural environment and resources, changes in land uses both in types and sizes, etc. As sample survey indicates, 311 or 74.2% of the total sample HHs have holdings which are small in size, fragmented, and scattered. The number of fragmented holdings range from two to five plots and about 56.2% of the total sample holders have farm plots that are fragmented into three and four different locations and the size of the smallest fragmented plot is not greater than 0.25 ha. Households who have fragmented holdings of this size account for 60.9% of the total sample holders.

This problem of fragmentation manifested itself as a serious problem for most of the sample HHs after 1987/88, as the responses of the sample HHs indicate (tables 6 and 7 below).

Table 6: Sample HHs whose holdings are fragmented for 1997/98 and the time they began facing this problem seriously.

Conditions of holdings	' Dega'		'Weina Dega'		' Kola'		All zones	
	No	%	No	%	No	%	No	%
Fragmented	137	89.0	136	62.7	38	79.2	311	74.2
Not Fragmented	17	11.0	81	37.3	10	20.8	108	25.8
Total	154	100.0	217	100.0	48	100.0	419	100.0
The time since the sample HHs began facing serious problem of fragmentation								
Before 1977/78	11	8.0	5	3.7	4	10.5	20	6.4
Since 1977/78	67	48.9	56	41.2	21	55.2	144	46.3
Since 1987/88	59	43.1	75	55.1	13	34.2	147	47.3
Total	137	100.0	136	100.0	38	100.0	311	100.0

Source: Sample survey , 1997/98

Table 7: Sample HHs with their respective numbers of fragmented plots for 1997/98

Number of fragmented land plots	'Dega'		'Weina Dega'		'Kola'		All zones	
	No	%	No	%	No	%	No	%
2	43	31.4	63	46.3	4	10.5	110	35.4
3	54	39.4	54	39.7	14	36.8	122	39.2
4	25	18.2	17	12.5	11	28.9	53	17.0
5	15	11.0	2	1.5	9	23.8	26	8.4
Total	137	100.00	136	100.00	38	100.00	311	100.0

Source: Sample survey , 1997/98

3.3. Population And Changes in Land Use

The major land use types of Hitosa 'Wereda' comprise of settlement land, grazing land, crop land (cultivated land) and vegetation covered land (forests & wood lands) and some other land uses such as, water bodies, degraded or bare lands, etc. Forest land uses are mainly confined to the 'Dega' climatic zone or to the highly elevated part of the 'Wereda' and reliable information on its size could not be obtained. Rather, the only information obtained is that the forest land is shrinking rapidly from time to time.

Concerning settlement land uses, information that are obtained from the sample respondents does not clearly indicate its definite area. This is because most of the holdings of the peasant farmers are very small in size and are used for both settlement and grazing purposes. Besides this, the settlement compounds of some holders are indicated together with the cultivated land (crop land) due to the smallness of their holdings which made the separation difficult.

Land use types of permanent pasture are not found in any parts of the study area. Therefore, the researcher was unable to clearly present brief analyses on settlement, forest and permanent postural land uses separately because of the afore mentioned problems. However, he would like to inform that these land use types are discussed in combination with either grazing or cultivated land uses. Therefore, greater attention is paid to the analyses of the grazing and cultivated lands as these are the most important and significant types of land uses in the study area.

3.3.1. Grazing lands

The total area of grazing lands held by the sample HHs in 1977/78 was 59.25 ha. and accounted for about 11.2% of their total holding.(Fig. 4 below and app.3). This total size of grazing land was possessed by 183 sample holders who had different sizes, that range from an average of 0.25 ha. (the smallest size) to 1.25 ha. (the largest size). However, the overall average size of grazing land use of a sample peasant was 0.32 ha. although there were variations among the sample holders of different climatic zones. The average area of this land use type was 0.33 ha. for a sample holder in the 'Dega', 0.34 ha. for a sample holder in 'Weina Dega' and 0.25 ha. for that of the 'Kola' climatic zone. Among the total area of grazing land use about 39.9%, 52.1% and 9.0% were

accounted for the respective sample holders of the 'Dega', Weina Dega' and 'Kola' climatic zones. On the other hand, this land use type had accounted for 13.3%, 10.6% and 7.9% of the respective total land uses of the 'Dega', 'Weina Dega' and 'Kola' climatic zones.

In 1987/88 the total area of grazing land had decreased to 52.25 ha. while the number of the sample holders grew to 191 and average area of this land use that belonged to a sample holder decreased to 0.27 ha. During this time grazing land use accounted for about 8.7% of the total area of all land use types of the total sample holder but with different proportions for different climatic zones. (Fig 4 below and app.3). It accounted for about 12.1%, 7.2% and 6.6% of the respective areas of all land use types of the sample HHs of the 'Dega', 'Weina Dega' and 'Kola' climatic zones. Average areas of grazing lands of a sample HH of these three zones had decreased also to 0.27 ha. for the 'Dega', 0.28 ha. for 'Weina Dega' and 0.25 ha. for 'Kola' holders.

In 1997/98, the area of this land use type further shrank to 35.75 ha. and accounted for about 5.6% ((fig. 4) of the total area under all types of land uses. The number of sample HHs that had grazing lands by this year became 141 and the average area of grazing land of a peasant holder decreased to 0.25 ha. In 1997/98, this land use type accounted for about 8.9%, 4.9% and 4.9% of the respective total areas of all land use types of the 'Dega', 'Weina Dega' and 'Kola' climatic zones.

When the pattern of change in the area of grazing land use is observed, its total size, percentage share of the total area of other land use types and its average area per HH have decreased considerably since 1977/78. The total area decreased from 59.25 ha. in 1977/78 to 35.75 ha. in 1997/98. In similar condition its percentage shares declined from 11.2% to 5.6% of the respective total areas of all other land use types while the average area that belonged to a household declined from 0.32 ha. to 0.25 ha. This pattern of decreasing change is observed in each of the three climatic zones.

3.3.2. Cultivated Lands

The total area of land used under permanent cultivation by the sample HHs in 1977/78, 1987/88 and 1997/98 accounted for 79.2%, 83.7% and 86.9% of the toal areas of all land use types of the respective years (Fig. 4 and app. 3). The overall area of cultivated land uses of each of these

Table 10:- The major three types of animal feed used by the sample HHs.

Climatic zones	Major types of animal feed	up to 1977/78			1978/79 to 1987/88			1988/89 to 1997/98		
		1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
'Dega'	Natural pasture	79			108			136		
	Straw		57			100			127	
	Stubble			51			52			82
	Produced Fodder					1			1	2
'Weina Dega'	Natural pasture	95								
	Straw		73		112	103		117		
	Stubble			54			96		117	
	Produced Fodder						15			43
'Kola'	Natural pasture	21					17		16	
	Straw		18		31	26		38		
	Stubble			13					15	18
	Produced Fodder								1	7
All zones	Natural pasture	195		-						
	Straw	-	148	-	229			195	155	
	Stubble	-	-	114	-	148	143	2	132	100
	Produced fodder	-	-	-	-	1	15	1	5	52

N.B. The ranks 1st, 2nd and 3rd are the rank important of the animals feed used by the sample respondants.

Source: Sample survey, 1997/98

Such changes in the use of the types of animal feed i.e from greater dependency upon natural grazings to straw and then appearance of producing fodder have close relations to the gradual decreases observed in the relative sizes of grazing land uses that can be associated to scarcity in availability of natural grasses. This scarcity of available natural grazings started to appear as a serious problem for most of the sample HHs after 1988/89 as the sample respondents indicated (refer to table 11 below).

Table 11: Sample HHs reporting serious scarcity of natural grazing and time of occurrence.

The time since when the scarcity of natural grazing appeared as a serious problem	'Dega'		'Weina Dega'		'Kola'		All zones	
	No	%	No	%	No	%	No	%
Until 1977/78	3	2.3	28	19.7	3	8.8	34	11.1
Between 1978/79 and 1987/88	56	43.1	56	39.4	11	32.4	123	40.2
Since 1988/89	71	54.6	58	40.9	20	58.8	149	48.7
Total	130	100.0	142	100.0	34	100.0	306	100.0

Source: Sample survey, 1997/98

The problem of scarcity in natural grazings is therefore associated to the decreasing change in grazing land sizes of the sample peasants as has been explained in chapter 3, (3.2 and 3.3). the growing change in the population number. Accordingly, the decrease in the sizes of grazing land areas would limit areas of natural grazings which inturn would negatively influence the power producing capacity of the farm animals. In addition to this effect the amount of animal products such as meat, milk and milk products that could be obtained from these underfed farm animals would be adversely affected while the demand for these animal products is on growing due to population growth. Besides these the average income of a HH which could be obtained by the sell of the farm animals and/or their products will be reduced. Thus, all these problems have notable influence upon the crop producing capacity of the peasant farmer both directly and indirectly.

Therefore, all the combined effects of population growth, changes in land use patterns and the problems of shortages in animal feed supply, and others related to these would result in some changes in the types and methods of use of farm implements or tools, and farm powers of the peasant farmers in the crop production activities.

4.2. Uses and Sources of Traditional Farm Tools and Modern Farm Machinery

4.2.1. Traditional Farm Tools - Types, Sources and Importance

The types of farm implements/tools that are used by the peasant farmers are similar in types and are centuries old. All the farmers use the wooden made and oxen driven tools, mainly the plow and yoke (locally known as 'Mofer' and 'Kember') for cultivation purpose. These plow and yoke are made or prepared by the farmers themselves except the parts which are made of iron. The iron made part of the plow is the one that is known as 'Maresha' and is mainly produced by local handicraft and are available at all local markets of the peasants. However, in certain conditions when a farmer is unable to make his own wooden or leather made farm tools he can easily get them from his nearby fellow farmer with a little payment or by any means of award.

The important tools that are used for the purposes of threshing crops are the fork like materials named locally as 'Mensh' and are usually made of wood or iron, the spoon shaped materials called 'Lameda' which are made of wood, and thatch made sweepers that are known as 'Atola'. All these tools are produced locally by the peasant farmers and are also available in local markets at small prices. The most common type of tool that is usually used for the purpose of harvesting is the sickle which is bought from local markets. To prepare farm lands for cultivation and for any other clearing, cutting and digging purposes the peasants use usually the common materials such as the hoe and axe. These tools are available in any of the local markets of the peasants. Therefore, as presented above the peasant farmers of 'Hitosa Wereda' - the study area, obtain these necessary farm tools and materials either by producing at home or by buying them from the local markets. For instance, among the total of the sample HHs 71 of them or about 16.9% were getting these traditional tools totally by purchasing from their respective local markets while 348 or about 83.1% of them obtain both by producing at home and by purchasing (refer to table 12 below).

Table 12:- The major sources of traditional farm tools of sample HHs.

Climatic zones / Major sources of the traditional farm tools	'Dega'		'Weina Dega'		'Kola'		All zones	
	No	%	No	%	No	%	No	%
Local markets only	17	11.0	50	23.0	4	8.3	71	16.9
Both local markets and home production	137	89.0	167	77.0	44	91.7	348	83.1
Total	154	100.0	217	100.0	48	100.0	419	100.0

Source: Sample survey, 1997/98

The average annual expense of a peasant farmer for the purpose of buying traditional farm tools ranges from the smallest amount of Birr 25.00 to the highest amount of Birr 175.00 (Table 13 below). From the total of 419 sample HHs 217 or about 51.8%, spend upto Birr 50.00 while 176 or about 42% spend from Birr 51.00 upto Birr 100.00, 18 or about 4.3% spend from Birr 101.00 upto Birr 150.00 and 8 or 1.9% of their total spend from Birr 151.00 upto Birr 200.00 annually. The overall average amount of money spent per peasant farmer is Birr 53.20. Although the amounts of average expenditures are not similar for each of the sample peasants of different climatic zones, there is not big difference in their average expenditures.

Except three sample HHs from the 'Weina Dega' climatic zone, all of the sample peasants produce traditional farm tools mainly for the purpose of their own uses. Hence, the peasant farmers do not have any income earnings from the selling of such farm tools. The average amount of annual income earning of the three sample holders who sell traditional tools range from the minimum of Birr 40.00 to the maximum of Birr 180.00 and their overall average annual earning per HH amounts to Birr 90.00 in general.

Table 13: Sample HHs by average amount of expense to buy traditional farm tools.

Climatic zones	'Dega'		'Weina Dega'		'Kola'		All zones	
Average amount of expenditure/HH (in Birr)	No	%	No	%	No	%	No	%
< 50.00	71	46.0	115	53.0	31	65.6	217	51.8
51.00 -100.00	75	47.8	92	42.4	9	18.7	176	42.0
101.00 - 150.00	6	3.9	5	2.3	7	14.6	18	4.3
151.00 - 200.00	2	1.3	5	2.3	1	2.1	8	1.9
Total	154	100.0	217	100.0	48	100.0	419	100.0
Average amount of expense, per HH (in Birr)	55.20		52.00		52.00		53.20	

Source: Sample survey, 1997/98

4.2.2. Modern Farm Machinery - Types, sources, and availability.

Hitosa 'Wereda' is one of the major crop producing areas of the Arsi administrative zone and there is intensive crop farming practice in most of its areas. More than 95% of the peasant farmers practice mixed farming with great emphasis on the production of food crops mainly the cereals. In this 'Wereda', during the past socialist revolutionary period there were vast areas of state farms which were developed over the nationalized private large farms of the pre-socialist revolution times. But currently though they are not as wide as they were previously, there are still two modernized large farms which are under the management of the ESSE. Hence, the presence of such modern large farms and wide spread of extension services contributed a lot to the growing uses of modern farm machinery (mainly tractors and combiners) and also to the uses of modern inputs although the degree of usage varies from HH to HH and from place to place within the 'Wereda'. The use of modern farm machinery and inputs seem to expand among most peasants since the number of tractors and combiners that operate in the area and the amount of farm inputs distributed appear to increase gradually (personal observation and information obtained from the 'Wereda's' Office of Agricultural Development).

The most widely used types of modern farm machinery in the study area are tractors for major purpose of cultivation and combiners for crop harvesting and threshing. These farm machinery provide their services to the peasant farmers by renting and the supplies are obviously accomplished in cash payments. The amounts of charges for the services' offered differ from time to time whereas the means of payment remain the same i.e. in cash. The major suppliers of these modern machinery are both private traders and government agencies such as the MOA and ESSE which are found in the 'Wereda' and some owners who come from other localities like the Nazreth, Assela, Bekoji, Addis Ababa and other centers. But prior to the current market economic policy, the major suppliers of these machinery were the cooperative organizations of peasant farmers, the MOA and the ARDU project specially during the past socialist system.

There is a remarkable change in the use of tractors and combiners since the year 1977/78 in the area, as the information of the sample survey indicates. The number of peasant farmers that used modern machinery have shown a considerable growth from time to time. The farm areas of the peasants which are cultivated by tractors and the amounts of crops that are harvested by use of combiners have increased rapidly although differences can be observed among the peasants of different climatic zones in such uses. According to the indication of this sample study, in 1977/78 it was only 11 or 4.8% of the total sample HHs who used tractors (all were from the 'Weina Dega' climatic zone). Similarly the number of sample HHs who used combiners were only 10 or about 4.4% and all were from the 'Weina Dega' zone (app. 4 and 5). But in 1987/88, these numbers of peasant holders who used tractors and combiners were 42 or about 12.8% and 50 or about 15.3% of the total sample peasants respectively. Still among these sample users the largest proportion was accounted for the peasant farmers of the 'Weina Dega' climatic zone and it was for about 85.7% of the total tractor users and about 82.0% of the total combiner users of the study area. The remaining respective percentage differences were accounted for the farmers of the 'Kola' climatic zone. In 1997/98 the number of sample HHs who used tractors amounted to 159 and accounted for about 38% while the number of sample peasants who used combiners had grown to 167 and accounted for about 39.9% of the total sample HHs.

Out of the total number of sample HHs that used tractors in 1997/98, 29 were from the 'Kola' 127 were from the 'Weina Dega' and 3 were from the 'Dega' climatic zones and they respectively accounted for 18.2%, 79.9% and 1.9% of the total tractor users. These tractor users accounted for about 1.9%, 58.5% and 60.4% of the respective total numbers of crop producer sample HHs of the 'Dega', 'Weina Dega' and 'Kola' climatic zones (App. 4). The distributional pattern of combiner user sample HHs of the three climatic zones also reflects a similar pattern to the tractor users. Accordingly, the total number of combiner user peasants of the 'Dega', 'Weina Dega' and 'Kola' zones were 3, 135 and 29 respectively and accounted for about 1.9%, 62.2% and 60.4% of their respective total numbers of sample HHs by 1997/98 (App. 5).

The total area of farm lands that was cultivated by the use of tractors also showed similar patterns of changes and distributions as related to the tractor user sample HHs. This total area of peasant farms that were cultivated by tractors in 1977/78, 1987/88 and 1997/98 was 13.75, 47.00 and 156.75 ha. respectively, and accounted for about 3.3%, 9.3% and 28.5% of the total areas of cultivated lands of the sample HHs of these respective years (App. 4). The areas that were cultivated by tractors in 1977/78 were totally from the 'Weina Dega' climatic zone and accounted for about 5.9% of its total areas of cultivated lands. By 1987/88, out of the total tractor cultivated area 42.00 ha. or about 89.4% was from the 'Weina Dega' and the remaining 5.00 ha. or about 10.6% was from the 'Kola' climatic zone. During this production year the respective areas of tractor cultivated farm lands of the 'Weina Dega' and 'Kola' zones accounted for about 13.8% and 8.4% of their respective total areas of cultivated lands. In 1997/98, among the total areas of tractor cultivated peasant farms, 28.25 ha. or about 18% belonged to 'Kola', 126.25 ha. or about 80.5% belonged to the 'Weina Dega' and 2.25 ha. or 1.4% belonged to the 'Dega' climatic zones. The respective total areas of tractor cultivated farms of these three climatic zones account for about 42.5%, 38.1% and 1.5% of their respective total areas of cultivated lands by 1997/98.

A wide range of variation is observed in the sizes of the individual farm lands which are cultivated by tractors and in the number of sample HHs who used tractors. In 1977/78 for instance, the smallest area of the tractor cultivated farm land was 0.25 ha. and the largest area was 2.25 ha. and the difference between these two was 2.00 ha. The average area of tractor cultivated farm of a tractor user sample household was 1.25 ha. with standard deviation of 0.68 and the difference in their areas of tractor cultivated farms had a coefficient of variation of 54.4%. In the year 1987/88, the smallest area of tractor cultivated farm land was 0.25 ha. while

the largest area of this farm was 2.75 ha. and the range was 2.5 ha. The average area of tractor cultivated farm land of a sample holder was 1.12 ha. with mean deviation of 0.65 and coefficient of variation of 58%. Thus during this time more than 57% of the various sized farm plots which were cultivated by tractors had sizes of less than the average. A similar situation was revealed in the 1997/98, but a slight change was seen in the range between the smallest and largest sizes of the tractor cultivated peasant farms. The smallest size was 0.25 ha. while the largest was 2.25 and the range became 2.00 ha. The average area of tractor cultivated lands of a tractor user sample holder was 0.99 ha. with mean deviation of 0.62 and coefficient of variation of 62.6%. By 1997/98, the number of tractor cultivated farm plots that had sizes of less than 1.00 ha. (or the mean) accounted for more than 59% of the total number of tractor cultivated farm plots of varying sizes.

Generally as indicated by the data presented in App. 4 the significant changes that were revealed in conditions of use of tractors are that the number of tractor user sample HHs and the total areas of tractor cultivated farms increased while the average size of tractor cultivated farms of the peasants decreased and so is the mean deviation. The variations among the average sizes of these farms of the individual holders increased while the ranges between the largest and smallest sizes of tractor cultivated farm plots decreased with the changes in time. All these major changes have therefore strong associations to the growing changes of rural population that leads to growing changes in numbers of rural HHs, decreases in average sizes of land holdings, changes in the patterns of rural land uses, and changes in the methods and types of the tools and technologies that could be used in various activities of crop production.

It has to be noted that the tractor and/or combiner user sample peasant farmers do not totally depend upon these modern farm machinary in all activities of their cultivation and crop harvesting practices. Rather these machinery are used as supplementary sources of farm labour to their human/animal/labour specially when the peasants face problems in use of these traditional labour sources. Hence, the peasant farmers use these modern farm machinery to cultivate and harvest only some portions of their total lands and crops harvested. Accordingly, the services of tractors are required mostly for the purpose of first and/or second cultivations of either all or parts of their wheat farms and use combiners to harvest all or some portions of their wheat crops and rarely for other types of crop farms and crop harvests. Besides this most of the peasant farmers rarely use these machinery constantly year after.

A considerable growth change is also observed in the use of combiners in their crop production practices. Hence, there is increasing change in the amounts of crops harvested by combiners as indicated by the sample peasant farmers of the study area (App. 5) although the pattern of usage is variant among the user peasants of different climatic zones. The total amount of combiner harvested crops by 1977/78 was 345 quintals and accounted about 3.2% of the total volume of crops harvested by all of the sample HHs. All of these combiner harvested crops were harvested by 10 combiner user sample peasants of the 'Weina Dega' and accounted for 5.8% of the crops harvested by the total sample peasants of this climatic zone. In 1987/88 1425 quintals of crops were harvested by the use of combiners and 50 sample HHs used it (out of which 41 were from the 'Weina Dega' and 9 were from the 'Kola' climatic zones).

This total amount of combiner harvested crops accounted for about 9.7% of the total crops produced by the sample holders and the number of the sample HHs who used combiners accounted for about 15.3% of the total sample HHs of the time. In 1997/98. the volume of combiner harvested crops and the number of sample HHs who used combiners have increased. A total off 5333.5 quintals of crops were harvested by 167 sample HHs with the use of combiners. The HHs who used combiners accounted for about 39.9% of the total sample HHs while their combiner harvested crops accounted for about 28.9% of the total volume of crops produced by all of the sample holders. The number of combiner user peasants of this later year were 3, 135 and 29 for the respective climatic zones of the 'Dega', Weina Dega' and 'Kola' and accounted for about 1.95%, 62.2% and 60.4% of their respective total sizes of the sample HHs.

Within each of the three climatic zones, the volumes of combiner harvested crops and the number of combiner user sample peasants differ for the years considered. Accordingly, in production year of 1987/88, of the 'Weina Dega' zone, the combiner user peasants accounted for about 25.6% of their total sample number and the volume of combiner harvested crops which amounts to 1310.5 quintals accounted for about 14.8% of the total crops produced by all the sample HHs of this zone (app. 5). In this time the combiner users of the 'Kola' zone accounted for about 21.4% of the zone's total crop producer sample number while the amount of combiner harvested crops of 114.5 quintals accounted for about 7.1% of the crops produced by its sample holders. In 1997/98 the respective numbers of combiner user sample peasants accounted for about 1.95%, 62.2% and 60.4% of the 'Dega', 'Weina Dega' and 'Kola' climatic zones' of their respective total sample HHs who produced all types of crops. The respective volumes of

combiner harvested crops which amounted to 31.5 quintals for the 'Dega', 4577.5 quintals for 'Weina Dega' and 724.5 quintals for the Kola zones accounted for about 0.7%, 39.8% and 34.7% of their total amounts of crops produced by their sample HHs.

Volumes of combiner harvested crops of each combiner user sample HHs are also variant as observed through the times of the three years. For the peasants of 'Weina Dega' in 1977/78, the smallest and the highest volumes of combiner harvested crops of sample HHs were 10.5 and 90.5 quintals respectively while the average amount of this crop per sample peasant who used combiners was 34.5 quantals with mean deviation of 23.3 and coefficient of variation of 67.1%. By 1987/88, however, these volumes of the respective harvests, were 10.5 and 90.5 quintals for the minimum and maximum amounts of the 'Weina Dega' and 10.5 and 30.5 quintals for the 'Kola' zones. The average amounts were 32 quintals for the 'Weina Dega' while its standard deviation was 20.9 and coefficient of variation was about 65.4%. This average volume for a combiner user of the 'Kola' zone was 12.7 quintals with standard deviation of 63 and coefficient of variation of 49.4%. By 1997/98, although the minimum and maximum amounts of these crops that have been harvested by combiner users ranged from 10.5 quintals to 90.5 quintals respectively, the average volumes of combiner harvested crops by a single sample peasant amounted to 10.5, 33.9 and 25 quintals for the respective 'Dega', 'Weina Dega' and 'Kola' zones while the overall total average was 31.9 quintals with coefficient of variation of about 57.6% and mean deviation of 18.4 quintals.

4.2.3. Major problems in the Uses of Modern farm Machinery.

Although there could be several problems that face the peasant farmers of different climatic zones depending upon their various local situations, fragmentation of farm lands, the high costs of the services and scarcity in the supply of these machinery in time of needs are the most common.

As it was observed above the average land holding size of each peasant farmer decreased from time to time in relation to the growing number of rural population. Besides this situation, in the farming practices of traditional agriculture various types of crops, (usually more than two and three types) are grown on several smaller farm plots. Therefore the average area of a farm plot which would be used to produce a specific type of crop usually becomes smaller and smaller (the average holding size of less than one hectare which is indicated earlier under Chapter 3

(3.2), of this study can be sighted here as an example). Therefore the uses and applications of modern farm machinery on such small sized farm plots becomes gradually difficult, problematic and impracticable. This diminishing sizes of the average holdings and fragmentation of farm lands is becoming one of the major current problems for most of the sample HHs who use modern farm machinery as this study indicates. Those peasant farmers who have faced this problem amount to 110 and account for about 65.9% of the total sample number of the users of modern machinery (table 14 below).

The other most important and considerable problem of the peasant farmers' in the use of modern machinery is the high and increasing costs of the payments for the various services they provide to the users. The current charges for the services provided by tractors and combiners are high and are increasing from time to time while on the other hand the average farm income levels of each peasant household shows very weak and little improvements. Because of the fact that the principal sources of farm incomes of almost all crop producer peasants are his farm lands, the volumes of his crops harvested depend much upon the relative sizes of his crop farms since the productivities of the traditional practices are small. These average sizes of farm holdings of each peasant decreased as the result of the negative influence of the rapidly growing number of the rural people. Therefore the average volume of his crop harvest would remain to be very low and surplus production could not be sufficiently obtained and marketable surpluses can rarely be produced. Even if the peasant is able to harvest some marketable amounts it may not be sufficient enough and may not meet his consumption level and meet his cash needs only for home purposes. It seems for this major reason that all of the sample HHs who use combiners and/or tractors have indicated that high costs of the services provided by these machinery as their major problem (table 14 below). But the peasant farmers have indicated that they have growing need (table 15 below) to these uses of machinery so as to be assisted to improve their low levels of productivity and production.

The average amounts of payments that a user peasant has to accomplish in order to get the cultivation services of tractors through the specific means of rent have shown rapid increament specially in these recent years. Before 1977/78, the average amount of payment for first cultivation of farm lands by use of tractor was about Birr 24.00 per ha. and ten years later it grew to about Birr 50 and now it is about Birr 148.00. For second cultivation service that is provided by tractor the average amount of rental payments per hectare of farm land cultivation

were Birr 12.00 and 25 for the respective 1977/78 and 1987/88 whereas it was raised to Birr 80.00 in 1997/98. Therefore the service costs have shown increasing rates of about 10.8% and 19.6% per year with in these two respective periods. On the other hand, the average amount of all types of crops harvested by each sample peasant farmer which was 47.7 quintals in 1977/78 had decreased to an average of 45 quintals in 1987/88 and to 44.1 quintals in 1997/98 (Refer to app. 13). Thus with these average amounts of harvested crops the average decreasing rate becomes about 0.4%/yr which is an opposite rate of change when compared to the increasing rate of change of the service costs of modern farm machinery. Similarly the average market prices of the harvested crops showed a weak rate of improvement i.e. 4.1%/year as compared to the increasing rate of the service costs of the machinery. Therefore, it is because of this opposite relation that all of the sample HHs who used modern farm machinery indicated that the high costs of the service payments as their major problem in their use of these farm machinery (table 14 below).

Table 14:- Major problems encountered by sample HHs related to the use of farm machinery.

Sample HHS by climatic zones	'Dega'		'Weina Dega'		'Kola'		All zones	
Major problems	No	%	No	%	No	%	No	%
Farm land fragmentation	2	66.7	88	65.2	20	69.0	110	65.9
High costs of their services	3	100.0	135	100.0	29	100.0	167	100.0
Un suitable relief condition	1	33.3	29	21.5	8	27.6	38	22.8
Scarcity of supply of the machinery	3	100.0	118	87.4	28	96.6	149	89.2
Total	3	100.0	135	100.0	29	100	167	100.0

Source:- Sample survey, 1997/98

The other major problem of the peasant farmers in the use of modern machinery is the condition of availability of these required farm machinery particularly during the right working times. Tractors and combiners are highly demanded during the working times when each and every crop producer peasant is in urgent need for additional labour supply i.e the peak working times. These peak times are the crop sowing and crop harvesting periods. Therefore, since the use of modern machinery is important to complement the scarcity problems of farm animal labour and human labour supplies and because they are useful for their working efficiencies tractors (table 15 below) are highly demanded during the crop sowing periods while combiners are highly required during the crop harvesting periods.

Table 15:- Sample households reported for their major reasons to use modern farm machinery.

Sample HHS by climatic zones	'Dega'		'Weina Dega'		'Kola'		All zones	
Major reasons indicated	No	%	No	%	No	%	No	%
Scaricity of human labour	-	-	378	27.4	7	24.1	44	26.3
Scarcity of Animal labour	2	66.7	130	96.3	28	96.6	160	95.8
For working efficiency	3	100.0	113	83.7	10	34.5	126	75.4
For cheapness of payments for the services	-	-	4	3.0	-	-	4	2.4
To modernize farming	1	33.3	89	65.9	8	27.6	98	58.7
Total	3	100.0	135	100.0	29	100	167	100.0

Source:- Sample survey, 1997/98

In these short working times every peasant farmer who is able to use the machinery demands for their service. Moreover in these periods the machinery work intensively day and night on the farms of their owners and so are demanded or required most both by the possessers and also by

the peasant farmers. It is due to this overlapping demand condition that scarcities occur in the availability of the machinery in such urgent peak working times. Therefore the peasant farmers indicated this shortage of supply of the services of farm machinery as one of their principal problems and 89.2% of the user sample peasant responded for this problem (table 14 above). Although this is a common problem for all users its degree varies from one zone to another in the 'Wereda'. The climatic zone which suffers most from scarcity of farm machinery' is the 'Dega' followed by the 'Kola' zone while the 'Weina Dega' is relatively in better condition. The number of sample peasants who are users of modern farm machinery and those who indicated the shortage of supply as their major problem account for 100% of the 'Dega''s and for about 96.6% of the 'Kola' 's peasant users while it accounts for about 87.4% of the total users of the 'Weina Dega' sample HHs.

Other problems of the peasant farmers in the use of modern farm machinery are mainly associated to local conditions and among these include the problems related to relief conditions and is mainly common in the 'Dega' and 'Kola' climatic zones. As indicated by the responses of the sample HHs that use machinery unsuitable relief condition is a problem for about 33.3% of the 'Dega', 27.6% of the 'Kola' and 21.5% of the 'Weina Dega' climatic zones'. Because of the physical condition related to the presence of several ups and downs as the result of the locations of various farm plots such unsuitable reliefs cause difficulties in the applications of modern machinery labour over such areas.

Regardless of the problems discussed above, the need of the peasant farmers to the use of these modern farm machinery is growing significantly, and it can be possible to infer this growing need from the increasing number of the modern machinery user peasants. The number of sample HHs who used tractors and combiners in 1977/78 was only 11, in 1987/88 it grew to 50 and in 1997/98 it reached 167, and with these growing figure it has shown an average growth rate of about 75.9% per year. In addition to this numerical growth the changing needs of the sample households was also indicated by themselves. Out of the total sample HHs who use modern machinery about 93.4% indicated that they have growing need to use modern farm machinery in their crop production practices (table 16 below).

Table 16:- Sample HH responses for their needs to the use of modern farm machinery.

Climatic zones and sample HHS	'Dega'		Weina Dega'		'Kola'		All zones	
	No	%	No	%	No	%	No	%
Increased need	3	100	126	93.3	27	93.1	156	93.4
Decreased need	-	-	3	2.2	1	3.4	4	2.4
No change in need	-	-	6	4.4	1	3.4	7	4.2
Total	3	100.0	135	100.0	29	100	167	100.0

Source:- Sample survey, 1997/98

The major reasons that they indicated for their growing needs to use modern machinery include the reasons associated to the problems of scarcity of farm animal labour (which appeared in association with the growing problems in shortage of animal feed), the efficient working capacity of the machinery which contributes a lot to increase levels of productivities and productions by minimizing crop loses and to gradually change their traditional farming practices by using modern and efficient technologies and there by attempt to promote their low levels of productions and productivities.

CHAPTER 5

CROPPING PATTERNS AND FARMING PRACTICES OF PEASANT FARMERS

5.1. Areas and Major Types of crops cultivated

5.1.1. Total cropland areas of the sample households by major types of crops.

The respective total areas of cultivated lands under different types of crops for 1977/78, 1987/88 and 1997/98 were 420.5, 507 and 550.25 ha. (Table 17 below).

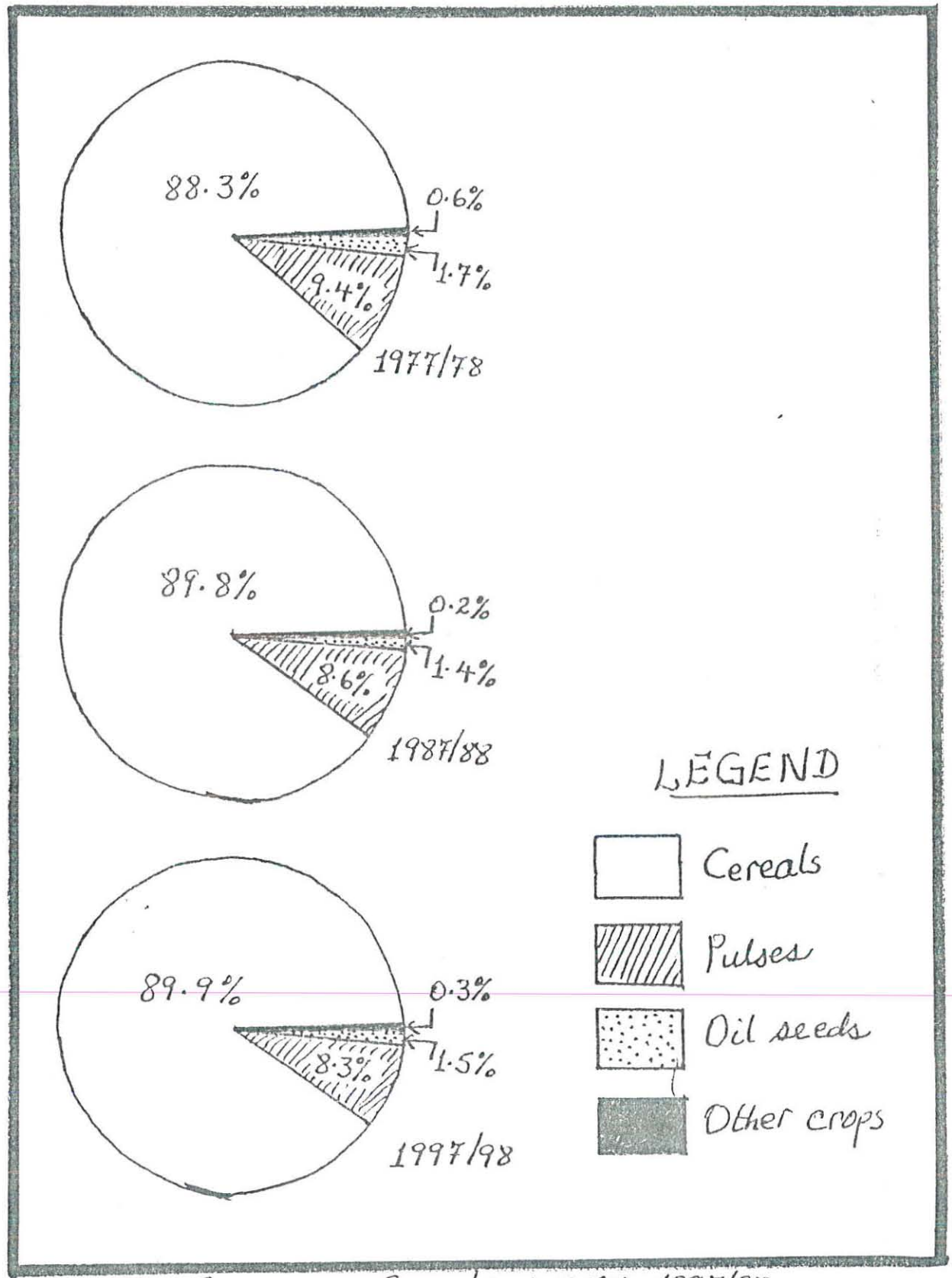
Table 17:- Cropland areas under major crops in 1977/78, 1987/88 and 1997/98.

Production years and Indicators of variations	All type of cropland		Cereal crops		Pulses		Oil seeds	
	Area (ha.)	%	Area (ha.)	%	Area (ha.)	%	Area (ha.)	%
1977/78	420.50	100.0	371.50	88.3	39.50	9.4	7.00	1.7
1987/88	507.00	100.0	455.25	89.8	43.50	8.6	7.00	1.4
1997/98	550.25	100.0	494.50	89.9	45.75	8.3	8.50	1.5
Rate of change/year (%)	1.54		1.65		0.79		1.07	
Mean	492.6		440.4	89.3	42.9	8.8	7.5	1.5
Standard Deviation	53.8		51.4		2.5		0.7	
C.V. (%)	10.9		11.7		5.9		9.5	

Source:- Sample survey, 1997/98.

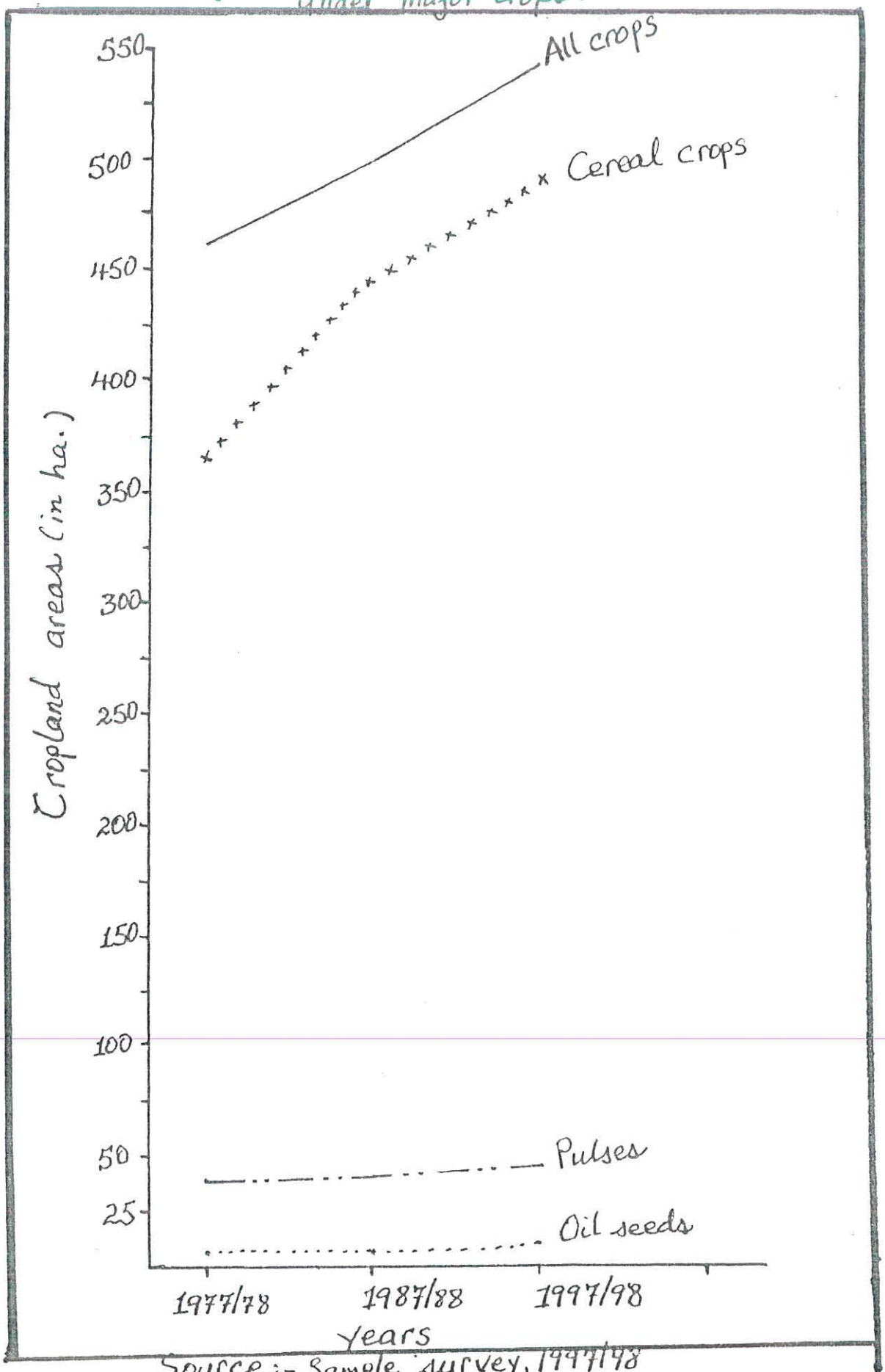
Between 1977/78 and 1997/98, the total area that was used for cultivation of major crops increased at an average rate of 1.54% per annum. The largest proportion of the total cropland area of the sample HHs was used for cultivation of cereal crops which accounted for about 88.3%, 89.8% and 89.9% in 1977/78, 1987/88 and 1997/98 respectively (Fig. 7 below). The second important crop in area occupation was the pulses and accounted for about 9.4% in 1977/78, 8.6% in 1987/88 and 8.3% in 1997/98 and followed by the oil seeds which occupied for about 1.7%,

Fig. 7:- Percentage distribution of areas under major types of crops of the sample HHs.



Source:- Sample survey, 1997/98

Fig. 8:- Cropland areas of the sample HHs under major crops.



Source:- Sample survey, 1997/98

1.4% and 1.5% of the total cropland area in these respective years. The area of cereal crops grew at an average rate of 1.65% per year whereas the corresponding changes for areas of the pulses and oil seeds were 0.79% and 1.07% per year respectively (table 17 above).

5.1.2. Average area of cropland of sample HHs

Although growth change was observed in the total area of the croplands, the average area of each cropland use of a sample HH decreased since 1977/78. The average cropland holding of a sample HH in 1977/78 was 1.84 ha. and decreased to 1.55 and 1.31 ha. in 1987/88 and 1997/98 respectively (appendix 6).

The largest proportion of the average cropland holdings of each sample HH was also dominated by the cereal lands and the temporal change was also similar to the general condition referred to above. The average area of cereal crops per sample HH in 1977/78 was 1.62 ha., of the pulses was 0.31 and of the oil seeds was 0.29 ha. But in 1987/88 these averages decreased to 1.39 ha. for cereal lands, 0.28 hectares for pulses and 0.25 ha. for oil seeds. In 1997/98, it reached 1.18, 0.28 and 0.25 ha. per HH for cereals, pulses and oil seeds respectively.

The cereal crops are produced or cultivated by every individual of the sample HH while the other crops are cultivated by a few of the sample holders. Accordingly, while all of the sample HHs in each of the respective three periods had cultivated one or two or more kind of the cereal crops, those who produced one kind of the pulses accounted for 56.3%, 47.1% and 39.4% of their respective total numbers in 1977/78 1987/88 and 1997/98. The oil seeds producers accounted also for about 10.5%, 8.6% and 8.1% of the respective sample HHs of these years (appendix 6). Therefore, the number of HHs of the producers of the pulses and the oil seeds decreased since 1977/78. This is because most farmers shifted their interest towards the production of some of the cereal crops as evidenced by the growing percentage shares of the total areas of the cereal croplands and the cereals producer sample HHs with gradual change of time.

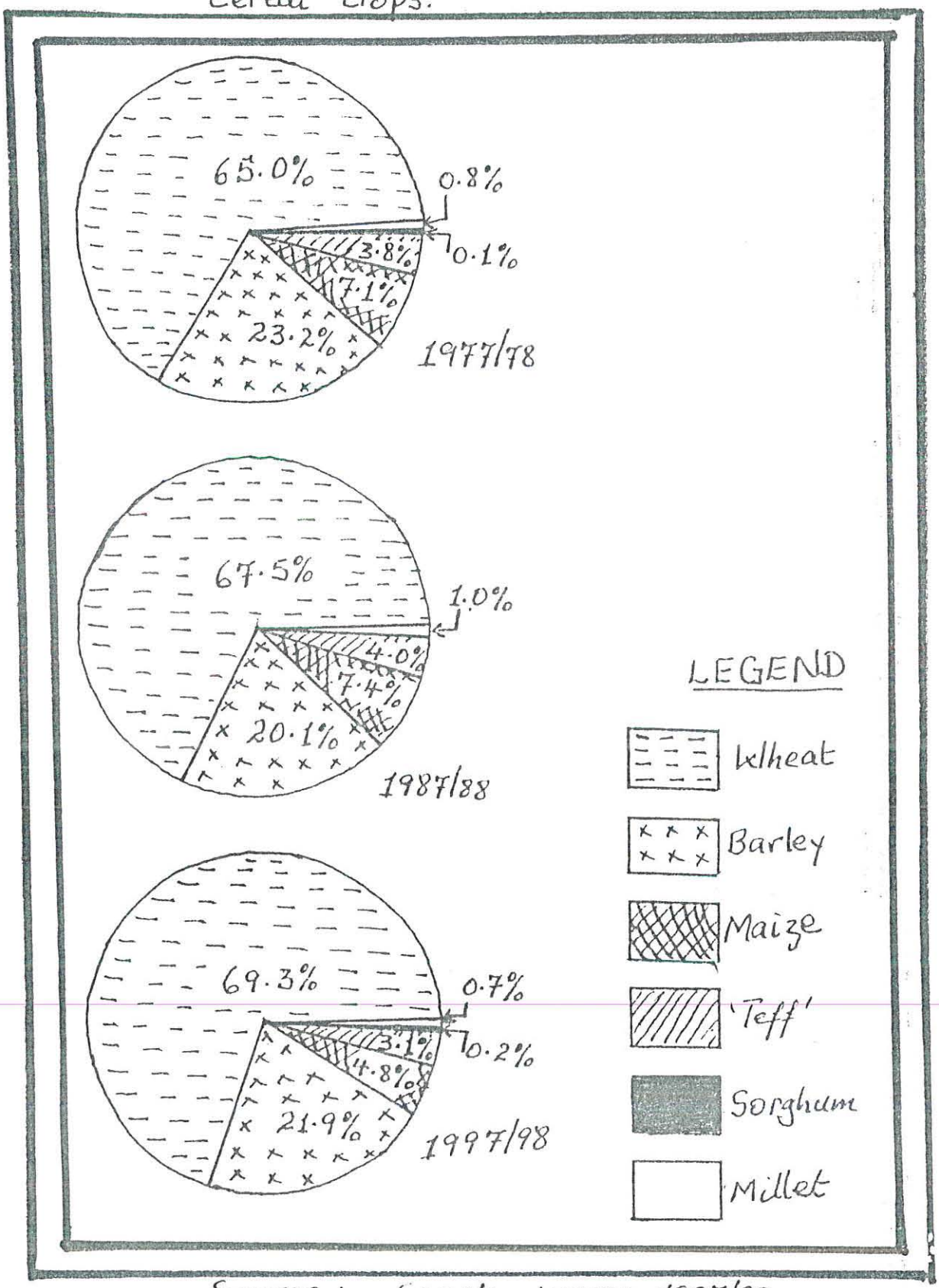
5.1.3. Major crops cultivated and their respective areas

The main types of crops grown by the peasant farmers of the study area, are the cereals such as Wheat, Barley, Maize, Teff, Millet and Sorghum; of the pulses (beans and peas) and of the oil seeds (linseeds) are the major ones. Among the cereal crops wheat, barley, maize and 'teff' are the four most widely produced crops in order of their importance and wheat has a

dominant position both in the total area it occupies and its total volume of production. It is also showing an increasing importance through time (appendix 6). Wheat alone accounted for about 65%, 67.5% and 69.3% of the total area of cereal crops and also accounted for about 61.8%, 67.2% and 75.1% of the total amounts of the production of cereals for the respective years of 1977/78, 1987/88 and 1997/98 . The average area of wheat farm of a sample HH is the largest of all other crop farms although it is decreasing gradually. The average size of wheat farm of a sample HH was 1.11 ha. in 1977/78 but decreased to 0.98 ha. in 1987/88 and became 0.86 ha. in 1997/98, yet it is the largest average size of all others. The second most important cereal crop is barley which accounted for about 23.2%, 20.1% and 21.9% of the total area of cereal crops (Fig. 9) below and for about 25.3%, 21.6% and 18.3% of the total production of the cereal crops for the respective years of 1977/78, 1987/88 and 1997/98 (Fig. 13 in chapter 5.4 below). Wheat and barley together accounted for more than 90% of the total area and total amount of production of the cereal crops of the sample HHs in 1997/98. The significance of barley is gradually decreasing both in the area it occupied and its total volume of production as indicated by the information of the sample HHs although it is the second most important cereal crop next to wheat. The overall average farm size of each type of cropland that belonged to each of the sample HH in 1997/98 was 0.86 ha. for wheat, 0.37 ha. for barley, 0.26 ha. for maize 0.25 ha. for sorghum and 'teff', 0.29 ha. for millet, 0.25 ha. for pulses and 0.25 ha. for oil seeds (Appendix 6). Except for wheat, the respective total and average area of all crop types of a sample HH had decreased very rapidly. But wheat had shown a rising dominance over the other crops. The reasons for the dominance of this crop can be associated with its relatively having better demand and market price, supply of variety of seeds and the relative ease in harvesting by using combine harvesters (as the peasant farmers indicated).

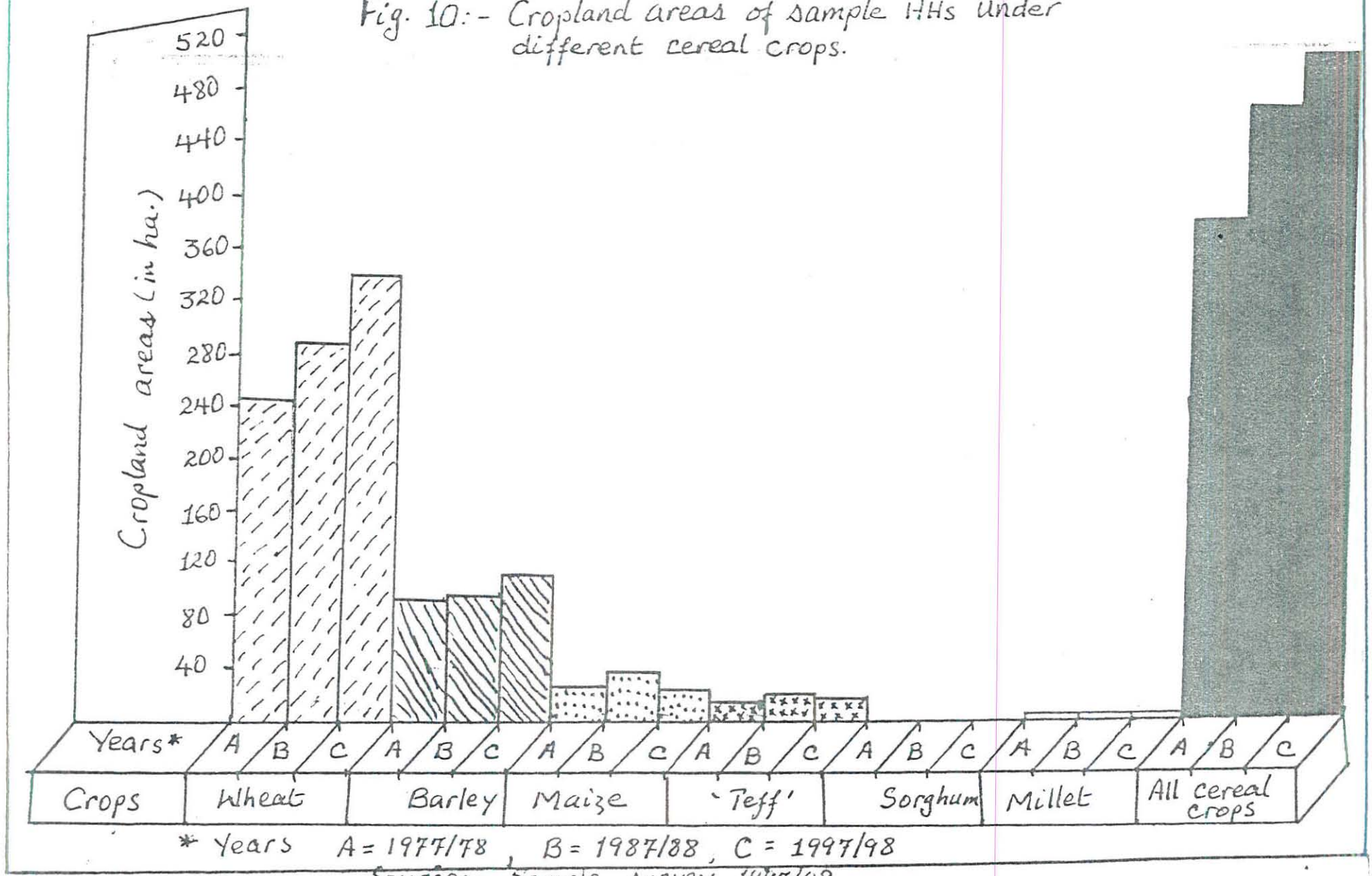
On the farm lands the majority of the peasants grow three main crops wheat, barley and maize while the minority of them grow only two or even one main crop as indicated by the sample holders. In his choice of crops the peasant farmer is mainly guided by his necessity and/or the importance of the crop for food purpose, its demand in the market, the nature of the crops resistance to natural hazards such as weeds, pests, frost, etc the yield and the labour requirement of the crop. Hence, the crop production practice of the people is gradually giving priority to the production of only one or two types of crops as evidenced by the increased importance of wheat, and even the food habit of the people is gradually shifting to wheat consumption.

Fig. 9 :- Percentage distribution of the cropland areas of the sample HHs under different cereal crops.



Source :- Sample survey, 1997/98

Fig. 10:- Cropland areas of sample HHs under different cereal crops.



* Years A = 1977/78, B = 1987/88, C = 1997/98

Source:- Sample survey, 1997/98

Generally, the average size of each cropland that a sample HH cultivates depends upon both the importance of the crop and the availability of the farmland at any period of time. Therefore, relatively larger average size of the farmlands are alloted to the cultivation of varied types of crops if the peasant farmer possesses relatively a larger size of holding. When his total cultivable land holding is small the allocation of larger proportion of his holding will be used for the cultivation of the crops that he assumes to be most important to him. In such situation priority is given to the cultivation of crops that have significant contribution to the food requirement and market needs of the farmer. Thus, it is due to this reason that croplands of wheat and barley have shown leading positions while the other farms have diminished in their respective sizes gradually.

5.2. Crop cultivation practices, The supply and uses of Modern Farm Inputs.

5.2.1. Crop cultivation practices of peasant farmers.

In the study area i.e Hitosa 'Wereda' initial plowing takes place in March/April when the soil is softened by the rains of these months. Starting from this period the peasants cultivate or plow their farms repeatedly for several times (usually ranging from four to five times) until the farm soil is softened and ready for sowing. Multiple plowing of farms depends upon the crop type, the natural character of the farm and the weed growing condition of the local environment. Most of the crops sown in the different climatic zones of this 'Wereda' require multiple plowing before sowing is finally made. Thus, farm plots that are intended for the cultivation of wheat, barley,' teff' and beans are cultivated repeatedly for about five or more times mainly over the 'Dega' and 'Weina Dega' areas. There is a small difference in sowing periods among different climatic zones for different types of crops. Peasant farmers of the 'kola' start sowing usually later and start harvesting sooner than the 'Dega' peasants. Everywhere in the 'Wereda' the stalk crops are sown sooner than other crops followed by the pulses and finally the cereal crops. Therefore average crop sowing periods for the 'Dega' areas extend from the mid of June to the mid of July, for the 'Weina Dega' it extends from the end of June to the end of July and in the 'Kola' areas it extends from July to the beginning of August. Weedings is performed after the end of sowing period and extends upto the beginning of September over most areas and even upto the mid of this month over the 'Dega' areas when rains last for longer period. Harvesting starts sooner in

the 'kola' and begins usually after the end of September. In the 'Weina Dega' it mostly starts in the mid of November and the 'Dega' after November. The other activities of crop cultivation such as threshing, winnowing, transport and storage are accomplished upto the months of December and January.

The peasant farmers attempt to maintain and control the natural fertility of the soil mainly by traditional methods. To control or prevent soil erosion/removal the farmers, especially those who are engaged in slope cultivation, practice contour plowing and contour terracing which are the most widely and commonly practiced methods. The major techniques of maintaining land fertility that most peasant farmers practice include crop rotation and the use of chemical fertilizers. In most areas of the 'Wereda' fallowing and dung manuring have been abandoned due to the growing population pressure on land and increasing diminution of holding sizes and decreased number of the farm animals of each HH. Basically farming activities are under taken by the use of traditional farm tools, animal and human labour. Most of the activities of harvesting, sowing, weeding and threshing are performed by the use of family labour. However, the use of modern farm machinery viz. tractors and combiners; chemical fertilizers; and weed killer chemicals appear to be used in supplement to the traditional practices and this practice is expanding over some parts of the 'Wereda' in recently.

5.2.2. Uses and supplies of modern farm inputs

One of the major characteristics of traditional agriculture is the low level of land and labour productivities. In relation to this, there is a remarkable change in the land-man ratio because of the exponential growth of population and weak expansion in cultivated lands. It has to be noted that in a country with traditional agricultural economy experiencing a rapid growth rate of population land available for cultivation would gradually decline or remain at most the same. Therefore, in such a condition an increased amount of food supply would be possible by improving the productivity of the farmer through raising the yield of the crops.

Hence, to meet the demand for additional food the peasant farmers of 'Hitosa Wereda' need to make an increased use of modern farm inputs to improve productivity. Of these modern inputs, the farmers in the study area make more use of chemical fertilizers, selected seeds, tractors and combiners.

5.2.2.1. Use of chemical fertilizers.

The number of sample HHs who made use of chemical fertilizers in 1977/78 was 109 and accounted for about 47.6% of the total sample holders. In 1997/98, this number has grown to 323 and accounted for about 77.1% of the total sample HHs (table 18 below). Within these twenty years, therefore, the number of sample HHs that used chemical fertilizers has grown at an average rate of about 9.8% per annum. The total amount of chemical fertilizer used in 1977/78 was 129.5 quintals and it was 259 quintals in 1997/98. Thus, the total volume of this input used increased at an average rate of about 5% per year. The total area of croplands over which chemical fertilizer was applied in 1977/78 was 178 ha. and it was 328 ha. in 1997/98. This area accounted for about 42.3% and 59.6% of the total area of the croplands of the sample HHs in 1977/78 and 1997/98 respectively. Therefore, the area of croplands over which chemical fertilizer was applied had shown an average growth rate of about 4.21% per annum.

However, In 1977/78, the average amount of chemical fertilizer that was used by a sample HH was 1.19 quintals but in 1997/98 this average was 0.80 quintals. The average amount of chemical fertilizer used by each of the sample HHs deviate from the respective mean values of these years by 0.60 quintals and 0.33 quintals. The respective variabilities among the user sample HHs were 50.4% in 1977/78 and about 41.3% in 1997/98. Therefore the average amount of fertilizer that a sample HH used has decreased by an annual average rate of 1.64%. Similarly, the average area of each sample HH over which the chemical fertilizers were applied decreased from 1.63 ha/HH per household in 1977/78 to an average size of 1.02 ha/HH per household in 1997/98. This mean area of fertilizer served croplands of a sample HH decreased by an annual average rate of about 1.87%. The average area of fertilizer served croplands of the user sample HHs deviated from the mean value by 0.69 ha. in 1977/78 and by 0.37 ha. in 1997/98 and the variabilities of these average area were about 42.3% for 1977/78 and 36.3% for 1997/98. The average rate of application of chemical fertilizers of a user sample HH was 0.73 quintals/ha of cropland in 1977/78. It was 0.79 quintals/ha. in 1997/98. The rate of fertilizer applications of the peasant farmers is very small as compared to the standard application of 100 to 150 kg/ha. The rate of improving change in its application is still very small and is growing at 0.4% per year (table 18 below).

Table 18 :- The use of chemical fertilizers by sample HHs in 1977/78, 1987/88 and 1997/98

Year		User sample HHs		Amount used (quintals)		Area applied on (ha.)		Amount applied per ha. (Quintals)
		No.	%	Total	Av./HH	Total	%	
1977/78		109	47.6	129.5	1.19	178.0	42.3	0.73
1987/88		220	67.3	273.0	1.24	323.0	63.7	0.85
1997/98		323	77.1	259.0	0.80	328.0	59.6	0.79
1977/78 To 1997/98	Range	214		129.5	0.49	150.0		0.12
	Mean	217.3		220.5	1.08	276.3		0.79
	Rate of change per year (%)	9.8		5.0	-1.64	4.21		0.41

Source:- Sample survey, 1997/98

5.2.2.2. Use of selected seeds

Regarding the use of selected seeds by the sample HHs, growth change is observed in general (table 19 below). The number of sample HHs who used selected seed in 1977/78 was 15 and accounted for about 6.6% of the total number of the sample households. In 1987/88 it amounted to 59 and accounted for about 18% of their total number and in 1997/98, these selected seeds users reached a total of 216 which accounted for about 51.6% of the total number of the sample HHs. In association with the growing number of the selected seeds user sample HHs both the total volumes and average amounts of this input have increased remarkably. The total volume of selected seed that was used by the sample users of 1977/78 was 17.5 quintals and the average amount used by a sample HH was 1.17 quintals with mean deviation of 0.43 quintal and variability of 36.8%. But in 1987/88 the total volume of selected seed used was 69.5 quintals while the average amount used by a sample HH was 1.18 quintals with mean deviation of 0.46 quintals and variability of about 39%. In 1997/98, the total volume used reached 269.5 quintals and the average amount used by a sample HH became 1.25 quintals which deviated from the mean by 0.50 quintals and had variability of 44.8%. The total cropland area served by selected

seed in 1977/78, 1987/88 and 1997/98 was 11.75, 44.75 and 161 hectares respectively, while the average area over which a sample HH had used the input in these respective years was 0.78, 0.76 and 0.75 ha.

The total area of the sample HHs that was served by selected seed in 1977/78 accounted for about 2.8% of the total cropland area of the sample HHs and this proportion was 8.8% in 1987/88 and 29.3% in 1997/98. Average amount of selected seed that a sample household had applied on one hectare of his cropland was 1.49, 1.55 and 1.67 quintals for respective years of 1977/78, 1987/88 and 1997/98. Therefore, the changes observed in the use of selected seeds are that the number of selected seed user HHs showed an average growth rate of 67% per annum. Corresponding to this change the total amount of the input used by the user HHs increased at average rate of 72% per annum. The area of the user sample HHs that was served with selected seed grew by an annual average rate of 63.1%. In similar situation to these, the rate of selected seed application of a farmer has shown a growing change with an average annual growth rate of 0.6%.

Table 19:- The use of selected seeds by sample HHs in 1977/78, 1987/88 and 1997/98

Year		User sample HHs		Amount used (quintals)		Area applied on (ha)		Amount applied per ha. (Quintal)
		No.	%	Total	Av./HH	Total	%	
1977/78		15	6.6	17.5	1.17	11.75	2.8	1.49
1987/88		59	18.0	69.5	1.18	44.75	8.8	1.55
1997/98		216	51.6	269.5	1.25	161.0	29.3	1.67
1977/78 to 1997/98	Range	201		252.0		149.25		0.18
	Mean	96.7		118.8		72.5		1.57
	Rate of change per year (%)	67.0		72.0		63.5		0.6

Source:- Sample survey, 1997/98

5.2.2.3. Use of chemical fertilizer and selected seed by climatic zones

The use of chemical fertilizers and selected seeds by the peasant farmers of different climatic zones of the study area do not have similarity although the overall changing patterns observed are more or less the same (app. 7 and 8).

The number of sample HHs who used fertilizer in 1977/78 from the 'Dega' climatic zone accounted about 53.9% of the total number of sample HHs of this area while the total amount of the input used was 54 quintals and was served over a total area of 63.5 ha. which accounted for about 47% of the total areas of croplands (app. 7). The average amount of fertilizer used by user HH and the average area its was applied on were therefore 1.13 quintals and 1.32 ha. respectively. The average rate of application was 0.85 quintals/ha. per sample HHs. In 1997/98, the sample households who used fertilizer accounted for 74% of their total number. The total volume of the chemical used grew to 86 quintals and the area which was served with fertilizer accounted for about 73% of the total area of croplands of the sample HHs of the "Dega " zone. Accordingly the average amounts of fertilizer used and cropland area served by this input by a sample user became 0.75 quintals and 0.97 ha. respectively which made the application amount to be 0.77 quintals/ha.

In the 'Weina Dega' climatic zones in 1977/78 about 42.9% of the sample HHs used 56 quintals of chemical fertilizer which was applied over 38.5% of the total cropland areas of its sample HHs. Thus, an average amount of 1.17 quintals of fertilizer was used by a sample HHs and the application rate was 0.62 quintals/ha. But in 1997/98, it was 80.2% of the total sample HHs of the 'Weina dega' zone who used 145 quintals of chemical fertilizer and applied it over a total area of 184 ha. or about 55.5% of the total cropland area of all the sample HHs. The average amount applied over one hectare of cropland area was 0.79 quintals. With these total amounts then the average amount of the chemical used and the average area of fertilizer served lands of a sample HH became 0.83 quintals and 1.06 ha. respectively. In the 'Kola' zone 46.4% of the sample HHs used 19.5 quintals of chemical fertilizer that was applied over a total area of 24 hectares or 47.5% of the total cropland areas of the sample households in 1977/78. Therefore, the average amount of the input used and the area of cropland served by fertilizer by a sample user of this zone were 1.5quintal and 1.85 ha. respectively. The average rate of application was 0.81 quintal/ha. In 1997/98, it was 72.9% of the sample households that used a total amount of 28 quintals of fertilizer over a total area of 37 hectares which accounted about 55.6% of their

total cropland areas. Thus, the average amount of fertilizer used and area of cropland served by a sample HH were 0.80 quintals and 1.06 ha. respectively.

Therefore, it can be generalized that the number of HHs who used fertilizers grew at rates of 6.9% per year in the 'Dega' zone 13.1%, in 'Weina dega' and 9.6% in the 'Kola' climatic zones (app.7). The respective total amounts of chemical fertilizer used by the households have shown average growth rates of about 3.0%, 7.9% and 2.2% for the 'Dega', 'Weina dega' and 'Kola' climatic zones while the average rates of growth changes in respective total areas of fertilizer applied croplands are about 3.7% for 'Dega', 5.2% for 'Weina dega' and 2.7% for the 'Kola' zones.

Selected seed was used by only 15 sample HHs in 1977/78. Among this total 3 sample users were from the 'Dega', 8 were from the 'Weina Dega' and 4 were from the Kola climatic zones (app. 8). These selected seed users of the 'Dega' accounted for about 3.4%, of the 'Weina Dega' 7.1%, and of the 'Kola' 14.3% of their total sample HHs. In 1987/88, it was 29 (23.2%) 22 (13.8%), and 8 (19.0%) of the respective 'Dega', 'Weina Dega' and 'Kola' climatic zones who used selected seed. In 1997/98, 71 (46.1%) of the 'Dega', 116 (53.5%) of the 'Weina Dega' and 29 (60.4%) of the 'Kola' sample HHs used this modern farm input.

The total amounts of selected seed used by the sample HHs of the 'Dega' zone in 1977/78, 1987/88 and 1997/98 were 4.5, 32, and 67.5 quintals respectively. The amounts of selected seed used by the sample HHs of the 'Weina Dega' zone in these respective years were 9.5, 30.5 and 166.5 quintals and these amounts for the sample users of the 'Kola' zone were 3.5, 7.0, and 35.5 quintals (app. 8).

Average amounts of selected seed used by a sample HH of the 'Dega' zone were 1.5 quintals in 1977/78, 1.10 quintals in 1987/88 and 0.95 quintals in 1997/98 (app. 8). These averages for sample users of the 'Weina Dega' zone were 1.19, 1.39 and 1.44 quintals; and for sample users of the 'Kola' zone were 0.88, 0.88 and 1.22 quintals for the respective years of 1977/78, 1987/88 and 1997/98.

The total area of the croplands on which selected seeds was applied in the respective years of 1977/78, 1987/88 and 1997/98 was 3.25 (2.4%), 20.25 (14.2%) and 36.25 (23.8%) hectares for the 'Dega' zone; 7.0 (3%), 21.0 (6.9%) and 103.0 (31.1%) hectares for the 'Weina Dega'; and 1.5 (3%), 3.5 (5.9%) and 21.75 (32.7%) hectares for the 'Kola' zones. (The figures in bracket are

the percentage shares of the selected seed served areas from their respective total areas of the croplands).

With regards to the application rates of selected seed by the sample users for the respective years of 1977/78, 1987/88 and 1997/98, it was 1.38, 1.58 and 1.86 quintals/ha. in the 'Dega' zone; 1.36, a.45 and 1.62 quintals/ha. in the 'Weina Dega' zone and 2.33, 2.00 and 1.63 quintals/ha. in the 'kola' zone (app. 8).

The major cropland that is served with both chemical fertilizers and selected seeds is mainly the wheat farm. Fertilizers are served on farms of teff and barley by some of the peasant farmers and these are the common practices of all of the farmers of every climatic zone.This is because, these crops contribute significantly to the economic needs of most farmers in the area.

The chemical fertilizers are supplied to the farmers by the MOA private trade companies mainly Dinsho, and individual private traders. Selected seeds are supplied by the ESSE (government enterprise) through the MOA. The private traders and companies provide chemical fertilizers on the basis of cash payment while the government agencies provide these modern inputs to the farmers on the basis of credit payment but with a down payment of about 20% of the total price. Except this difference in forms of payment, there is no other significant differences in the prices of the chemical fertilizers supplied by the government agencies, private companies and private traders. There is no shortage of chemical fertilizers and are distributed timely at every local market centers of any climatic zone. Rather the problem of scaricity manifests itself in the supply of selected seeds. The major differences in the use of modern inputs by climatic zones are mainly due to poor development rural roads mainly for 'Dega' and 'Kola' zones while the 'Weina Dega' is more favoured relatively.

5.3. The Need of the Peasant Farmer and His Access to The Use of Modern Farm Inputs.

It is an obvious fact that the basic source of farm incomes of the crop producer peasant farmers is the volume of his varied crops that are harvested from his farm plots or farm holdings. However, the average size of farm land holdings are seen decreasing gradually in response to the growing number of population (as has been referred to in Chapters 3 and 5 section 5.1 above). Hence, under such a situation of traditional production practice where the use of modern farm inputs is limited, amount of the harvest of a peasant farmer depends mainly upon the size of his cropland holdings. Accordingly, regardless of the negative influences of natural elements, one

would expect that the larger the farm land holding of a peasant is the better will be the volume of his crop harvest. But because the average holding sizes of each HH have decreased due to the growing pressure of population each peasant needs to raise his level of production through the use of modern farm inputs specially chemical fertilizers and improved seeds. In addition to this, each peasant farmer has a growing need to additional food production for his gradually increasing number of average family size. Therefore, the peasant farmer needs to improve his low level of production for the major reasons that he has to meet the growing demand of his family's food requirement in one hand and has to obtain some surplus that could be sold and bring some money required for, government and non-government payments (such as taxes, modern farm input credits etc..) and other social needs.

Therefore, each and every peasant farmer of this area has a growing need for the use of modern farm inputs. However, the access of the farmers to the use of these inputs is partly limited by their high costs which are rapidly rising. The farmers can not meet these high costs because of their low average farm incomes which are more affected under conditions of low and fluctuating market prices of their farm products. Generally, average incomes of the peasant farmers are influenced by the combined effects of several factors associated with economic, demographic and socio-cultural elements. Accordingly their access to the use of these modern farm inputs is closely related with these factors and most peasant farmers seem to be unable to afford enough of the modern inputs as evidenced by the small and decreasing amounts of the chemical fertilizers they used and their low rates of applications (refer in 5.2.2. above).

As indicated by the responses of the sample HHs, the respective number of the peasant farmers that used different amounts and types of modern inputs likely correspond to their different levels of earnings of average productions. (app. 9). According to this information, in 1977/78 the total number of sample HHs who used fertilizer accounted for about 47.6%and this percentage falls in the groups of the hHHs who produced average amount of crops of more than 21 quintals per head. In 1987/88, the sample HHs who used chemical fertilizers of different amounts accounted for about 67.3% and corresponds to the sample HHs that had average crop production amounts of more than 20 quintals/household. Those who used both selected seeds and chemical fertilizers accounted for about 18% of the total sample HHs and each of their average amounts of crop produced were more than 41 quintals but in differing amounts. A similar pattern of distribution is observed for the production year of 1997/98. Because the peasant farmers who

use selected seeds apply them in association with chemical fertilizers the users of improved seeds also necessarily use chemical fertilizers. Therefore, such farmers are all from the groups of sample households whose average volumes of crop production are relatively higher than the others. This is mainly because usages of modern farm inputs have close associations with the farm income levels or the economic capacities of the user households which in turn depend upon the various sources of farm incomes, the volumes of average productions, the market prices of both, modern farm inputs and the agricultural products.

The principal source of farm income for almost all of the sample HHs are the varieties of crops produced mainly wheat and barley. The other supplementary sources of incomes for some of the farmers include the farm animals and their products, sideline activities such as selling of labour to other farmers, trading for crops and animals, producing and selling of traditional farm tools (handicraft) etc. Although farm animals are mainly raised for the purpose of their source of draft power, they also assist the peasant farmers specially in times of critical needs for money. The peasants sell their sheep, goats, some of their heifers, bulls and the equines. Unless the peasant farmer is obliged by the urgency of his problems he does not sell his oxen or cows since these animals are the corner stone of his production practice and his family. Peasant farmers whose earnings are partly obtained from sideline activities are very small in number and they are those whose average amounts of crop productions are minimum and do not raise farm animals. Such peasants work on the farms of others on payments, trade for crops and animals particularly during the off-farm working times, produce and sell some simple types of traditional farm tools. Hence, the most important i.e. more than 95% of the total average earnings of the sample HHs come from the crops harvested and this is true for about 94% of the sample HHs (refer to app. 10).

According to the information of the sample HHs and their indications, their average annual gross earnings range from a minimum of Birr 3,615/HH . to the maximum of Birr 19,815/HH in 1997/98. Therefore, there is a significant difference in their average annual incomes as reflected by this wide gap of average gross earnings. More than a quarter (i.e 121 or about 28.9%) of the total sample HHs have average annual gross earnings estimated at Birr 3,615 per HH to Birr 5235 per HH and 336 or about 80.2% of the total sample HHs earn an annual gross averages of Birr 9,285 and less per HH. The overall total annual gross mean income of a sample HH is estimated at Birr 7616.7 in which these various income levels have a mean

deviation of Birr 2206.4 from the mean value and the coefficient of variation of 28.3%. (Out of the total observation, 48 sample HHs or about 11.5% earn their respective average gross farm incomes only from varieties of their crops harvested, and their mean annual gross income is estimated at Birr 5960.6/HH . Twenty two sample HHs or about 5.3% of them obtain their average annual gross earnings from their crops produced and from selling of their physical labour. The mean annual gross earnings of this group amounts to Birr 4425/HH of which about 98.4% of their source of average income is their respective crop harvested and 1.6% is their labour. The sellings of live animals and animal products provide the farmers with varying amounts of supplementary incomes for 324 or about 77.3% of the sample HHs with average annual incomes that range from Birr 100/HH to Birr 700/HH. The mean annual gross earning of a sample HH of this group is estimated at Birr 8365 out of which the average annual income earnt from the crop harvested is estimated at Birr 8028.3/HH and accounted for about 96% of the total average gross earning while the average income that is earnt from animals is estimated at Birr 336.9/HH and accounted for about 4% of the total average. The sample HH who get their respective average annual gross earnings from the crops they produced, varieties of side line activities and selling of their physical labour are 25 or about 6% of the total sample size. The mean annual gross income of a sample household in this group is estimated at Birr 3906.6. Among this total amount of mean annual gross earning, the mean earnings from crop harvested is estimated at about Birr 3237/HH, the mean earnings from side line activities is estimated at Birr 541.2/HH and the mean earnings from the sell of physical labour is estimated at Birr 128.4/HH per household. These three major sources of earnings accounted for about 82.9% for crops, 13.8% for side line activities and 3.3% for sell of labour respectively.

Regarding the average expenditures of the sample HHs for the production year of 1997/98, their gross average annual amounts range from the minimum of Birr 3,530/HH to a maximum of Birr 10,717/HH (refer to app.11). The Average annual gross farm expenditure of a sample HH refers to the major expenses that are used for the purposes of food , clothing, tax payments, and for some social reasons, of seed reserves, and of payments of the uses of the required modern farm inputs. The overall annual gross mean expenditure of the sample HHs is estimated at Birr 5753.1 which has a mean deviation of Birr 1977.2 from the mean value with coefficient of variation of about 34.4%. The relative amounts of average annual expenditures of a sample HH that is used for the main purpose of food reserves and other expenses range from

90.7% to 50.8% of his total average expenditure; for the purpose of seed reserves range from about 9.3% to 5.8% and for the purposes of uses of the required modern farm inputs range from about 32.3% to 6.1%, which are varying in proportion by depending upon the average annual income, amounts and types of the modern inputs used, the average family sizes and the average holding sizes of each sample HH.

The average gross expenditure of a peasant farmer who used modern farm inputs mainly chemical fertilizer, improved seeds, tractors and combiners varies from a minimum of Birr 243/HH to the maximum of Birr 3461/HH (app. 12). However, the total average expenditure of a sample HH of modern farm inputs user is estimated at Birr 1137.0/HH with a mean deviation of Birr 376.2 and coefficient of variation of about 33.1%. Since the affording capacity of modern farm inputs is directly related to the farm incomes of each peasant farmer, sample households whose average gross incomes are estimated at less than or equal to Birr 5235/HH didn't use any kind of the modern input (refer to appendix 12). These HHs are 96 in number and account for 22.9% of the total. The HHs who spent on the use of one or more types of these modern inputs are those whose farm income levels are estimated at more than Birr 5235/HH. According to the indication of the sample survey therefore the number of sample HHs that use one or more type of modern farm inputs and their respective amounts of annual expenditure on each of the inputs they used increases with their respective average amounts of annual farm income levels (app. 12). Accordingly 71 or about 16.9% of the sample HHs whose average annual gross incomes are estimated at Birr 5235/HH upto Birr 6045/HH used only chemical fertilizers. Each of these households spent average amounts of Birr 243/HH to Birr 365/HH on chemical fertilizer. Sample HHs who used both chemical fertilizers and improved seeds are 85 or about 20.3% of the total sample number. These farmers spent average amounts of Birr 688/HH upto Birr 1415/HH and possess average gross earnings that range from Birr 6045/HH to Birr 7665/HH. Chemical fertilizers, selected seeds and combiners were used together by only 8 sample HHs that accounted about 1.9% of the total observation. These farmers spent average amounts of Birr 975/HH to. Birr 1096/HH and each of their average gross earnings are estimated at Birr 7665/HH. The sample HHs who used chemical fertilizers, tractors and combiners are 36 (about 8.6%) whose each of average gross farm earnings are estimated at Birr 8475/HH upto Birr 11715/HH (app. 12). These farmers spent average amounts of Birr 692/HH to Birr 1655/HH. Sample HHs who used all of these modern inputs i.e chemical fertilizers, selected seeds, tractors

and combiners are 123 (about 29.4% of the total sample number) and spent average amounts that range from Birr 1176/HH to Birr 3467/HH on these inputs. Therefore it has to be noted that the respective average amounts of expenditure on the uses of each of these modern inputs of each sample HH and the proportion of his expenditure on the inputs he uses to his respective gross annual farm expenditure differ significantly among the user sample HH and is based upon his respective average amounts of farm income levels.

Generally chemical fertilizer is used by 323 (or 100% of the modern input users) sample HHs in varying amounts. Selected seed is used by a total of 216 (about 66.9% of the modern input users) sample HHs. The sample HH number who used tractors is 159 (49.2% of the modern input users) Those who used combiners are 167 HHs and accounted for about 51.7% of the modern farm input users. The percentage expenditures of each of the user HHs on chemical fertilizer range from 6.1% to 7.9%, on selected seeds from 6% to 10.6%, on tractor from 1.2% to 3.7% and on combiner from 1.9% to 10.1% of their respective total average amounts of farm expenditure per HH by depending upon their respective total average farm income earnings per HH. The overall total mean expenses of the user sample HHs of chemical fertilizers, selected seeds, tractors and combiners are estimated at Birr 461.8, 564.2, 202.8 and 383.2/HH respectively with their respective mean deviations of Birr 167.7, 183.9, 91.0 and 220.4 from their respective mean values and with their respective coefficients of variations of about 36.3%, 32.6%, 44.9% and 57.6%.

5.4 Patterns of Crop Production and Productivity

The total volume of crops produced by the sample HHs in 1977/78, 1987/88 and 1997/98 were 10,914, 14,724 and 18,477.5 quintals respectively (table 20 below). The total production volume had grown from 1977/78 to 1997/98 with an average increasing rate of about 3.5% per annum.

Total volume of the production of crops is highly dominated by the production of cereal crops whose total volume accounted for about 89.8% in 1977/78, 91.1% in 1987/88 and 92.1% in 1997/98 (table 20, and Fig.11 and 12 below) and the production of cereals have shown a growing dominance. The total production volume of pulses accounted for about 8.3%, 7.3% and 6.2% of the total amount of the production of crops in 1977/78, 1987/88, and 1997/98 respectively while the production volumes of oil seeds accounted for about 1.4% for 1977/78

and 1987/88 and 1.5% of the total production of 1997/98. The production amount of the cereal crops increased at an annual average rate of about 3.7%, of the pulses at an average rate of 1.3% per year and of the oil seeds at an average rate of about 4.1%/year. The production of oil seeds shows the highest variability as indicated by the coefficient of variation of about 24.3%and is followed by the production of the cereal crops that has a variability of about 22% while the production of pulses has the lowest variability which is about 9.7% only. The respective volumes of the production of each of these crop types deviate from their mean productions by 51.3 quintals for oil seeds, 2947.1 quintals for cereal crops and 101 quintals for the pulses.

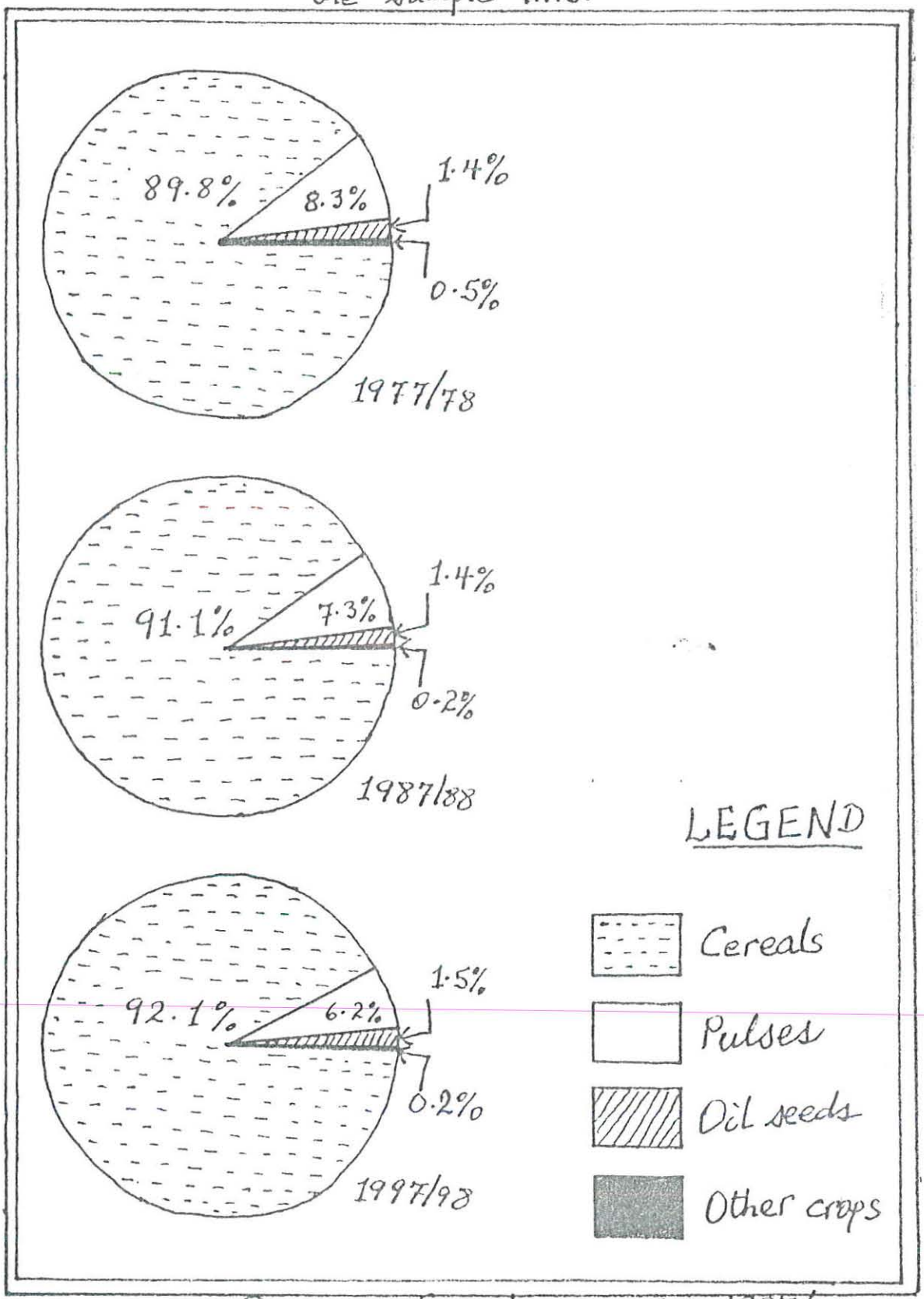
The cereal crops are produced by all of the sample HHs of the three production periods that are referred to in this study while the pulses and oil seeds are produced by certain number of these sample HHs. The pulses and oil seeds are mainly produced by the sample HHs of the 'Dega' climatic zone and specially oil seeds are totally produced in this climatic zone. Therefore, out of the total volumes of the production of pulses in 1977/78, 1987/88 and 1997/98 the production obtained from the sample HH of the 'Dega' zone accounted for about 58.2%, 62.4% and 67.4% respectively where as the second important producer climatic zone of this crop is the 'Weina Dega' which accounted for about 32.1%, 30.1% and 23.5% for the three respective production years. Accordingly the 'Dega' climatic zone has a leading position in the production of pulses than the 'Weina Dega' and 'Kola' zones.

Table 20:- Volumes of the crops produced by sample HHs with their pattern of change.

Years		Amounts of crops produced (in quintals)						
		All crops	Cereal crops		Pulses		Oil seeds	
			Amount	%	Amount	%	Amount	%
1977/78		10914.0	9802.0	89.8	905.0	8.3	152.0	1.4
1987/88		14724.0	13418.0	91.1	1075.0	7.3	204.0	1.4
1997/98		18477.5	17021.0	92.1	1146.5	6.2	277.0	1.5
1977/78 To 1997/98	Rate of change per year (%)	3.5	3.7		1.3		4.1	
	Range	7563.5	7219.0		241.5		125.0	
	St. Dev.	3087.7	2947.1		101.0		51.3	
	C.V. (%)	21.0	22.0		9.7		24.3	

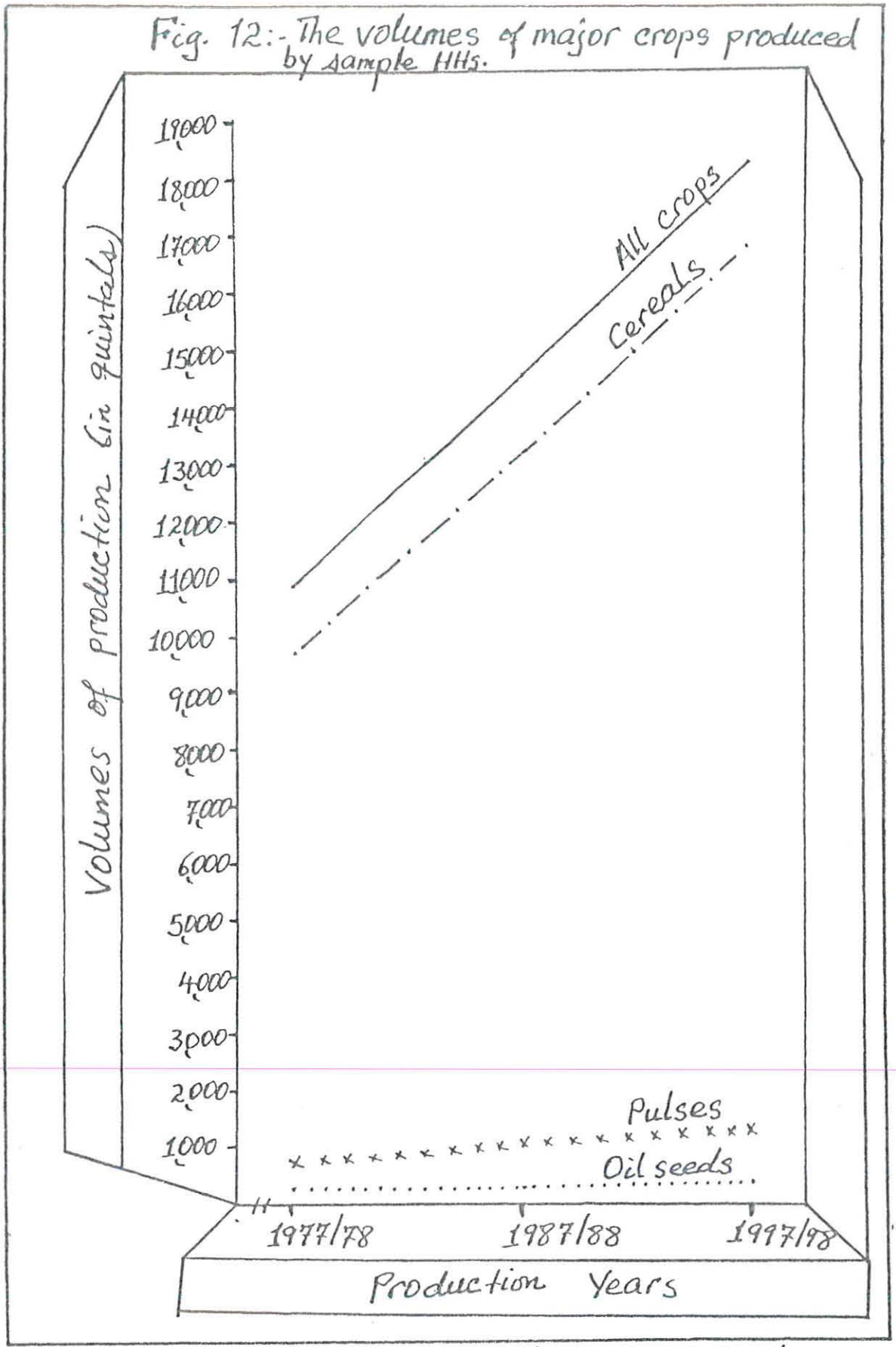
Source:- Sample survey, 1997/98

Fig. 11:- Percentage distribution of the Volumes of major crops produced by the sample HHs.



Source:- Sample survey, 1997/98

Fig. 12:- The volumes of major crops produced by sample HHs.



Source :- Sample survey, 1997/98

The average amount of production of all crops of a sample HH shows decreasing change since 1977/78 except for the oil seeds (app. 13). The overall average amount of total productions of crops per sample HH was 47.7 quintals in 1977/78, while it was 45 quintals in 1987/88 and 44.1 quintals in 1997/98. This average productions of cereal crops for each of these three years was 42.8, 41, and 40.6 quintals respectively, for pulses it was 7.0 quintals in 1977/98 and 1987/88 and is 6.9 quintals in 1997/98 per sample HH, while for oil seeds it was 6.3, 7.3 and 8.1 quintals/HH for 1977/78, 1987/88, 1997/98 respectively. The total productions deviate from their mean values of the respective years by 12.8, 14.3 and 16.4 quintals and with respective variabilities of 87.7%, 92.3% and 96.5% respectively for each years of 1977/78, 1987/88 and 1997/98.

In the crop production practices of the peasant farmers (as indicated by the information of the sample servey) the production of cereal crops occupies a dominant position as it possesses the largest proportion of the total area of croplands and volume of production of each year, as have been presented earlier. The major cereal crops that the sample HHs produce are wheat, barley, maize, 'teff', millet and sorghum in order of their importance (app. 13). Among these sorghum is produced only in the 'Dega' climatic zone while the rest are produced in all of the zones though in different proportion. Wheat, barley, maize and teff are the four most important cereal crops in their rank order which are produced by the largest number of the sample HHs, occupy the largest proportion of the cereal land area and also account for the largest percentages of the production volume of the crops produced in different years. Even among these the productions of wheat and barley dominate the others. Out of the total area of the croplands used for the production of all cereal crops and the total volumes of their productions in 1977/78, wheat alone accounted for about 65% (Fig. 9) and 61.8% (Fig. 13 below) respectively and barley accounted for about 23.2% and 25.3% respectively.

The total number of sample HHs who produced wheat accounted for 95.2% of the total sample HHs in 1977/78. while those who produced barley, maize, 'teff', sorghum, and millet accounted for about 84.3%, 37.1%, 24%, 0.4% and 5.2% of the sample households of this year respectively (app. 13).

The total amounts of each of the cereal crops produced i.e. wheat, barley, maize, 'teff', sorghum, and millet in 1977/78 accounted for about 61.8%, 25.3%, 7.3%, 4.8%, 0.1% and 0.7% respectively while the average amounts of productions of these respective crops were 27.8, 12.6,

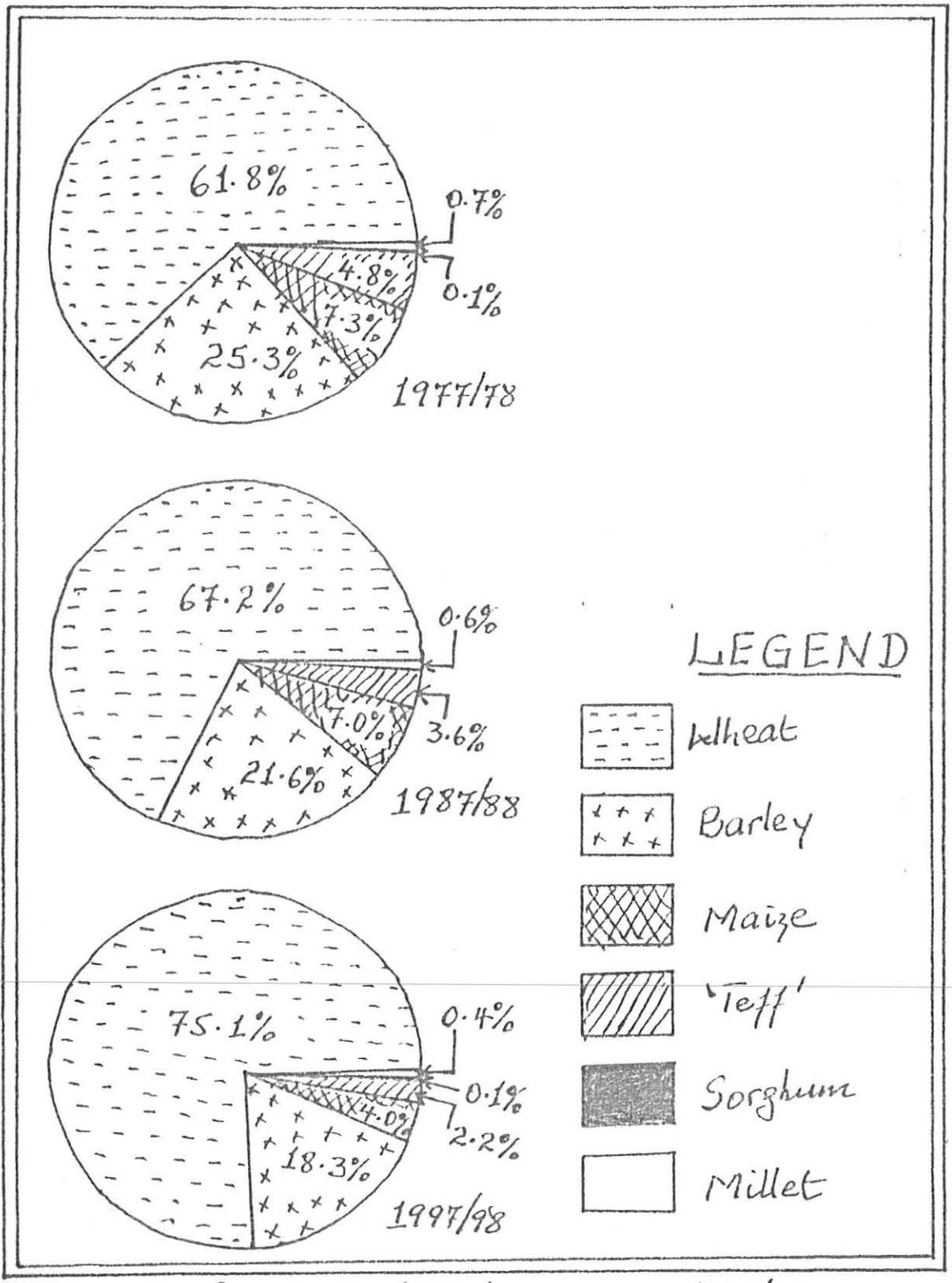
8.4, 8.6, 5.5 and 5.5 quintals/HH respectively (app. 13, and Fig. 13 & 14 below). On the other hand, the respective percentages of the sample HHs who produced these respective cereal crops in 1997/98 accounted for about 95.2, 70.6, 21.5, 14.8, 0.7 and 2.9% respectively (appendix 13) while the percentages of their respective volumes of production accounted for about 75.1%, 18.3%, 4.0%, 2.2%, 0.1% and 0.4% respectively. The average amounts of each of these cereal crops produced in 1977/78 amounted to 27.8 quintals for wheat, 12.6 quintals for barley, 8.4 quintals for maize, 8.6 quintals for teff, 5.5 quintals for each of sorghum and millet per sample HH and these averages in 1997/98 were 32, 10.5, 7.6, 6.0, 5.5 and 5.5 quintals/HH for respective crops. Within the production years of 1977/78 and 1997/98 the respective amounts of production of the cereal crops wheat, barley and sorghum have increased while the production amounts of maize and teff decreased and of the millet remained the same. With regards to the average production per HH, it is the average production of wheat which has ncreased from 27.8 quintals/HH in 1977/78 to 32 quintals/HH in 1997/98, while the average production of the other cereal crops have shown decreasing changes or remained the same for sorghum and millet.

When the yields of the crops are seen (table 21 below) their total average ranged from 26 quintals/ha. in 1977/78 to 33.6 quintals/ha. in 1997/98.

The major changes that are observed in the overall volumes of production of the crops are also seen in amounts of their overall yields although their particular changing conditions are different for different types of crops. The general average yields of crops increased at an average rate of 1.46% per year. The average yields of the crops deviated from the mean values of 29.5 quintals/ha year by 3.43 quintals/ha and its variability is 11.6%. From these groups of major crops, the cereal crops have the highest amount of average yield which is 30.1 quintals/ha and is followed by the oil seeds with average yield of 27.8 quintals/hectare/year whereas it is 24.2 quintals/ha for the pulses. The average yields of these crop types deviate from their respective mean values of yields by 3.29 quintals/ha for cereal crops, 1.59 quintals/hectare for the pulses and 4.54 quintals per hectare for oil seeds and their respective changes in their yields have variabilities of 10.9%, 6.8% and 16.3% respectively.

Generally, as it is briefly presented above, in the production practices of the sample HHs the major changes observed are that the total areas of the croplands increased at an average rate of about 1.54% per year, while the average area of the croplands that belonged to a sample HH decreased from 1.84 ha. to 1.31 ha. and the change is similar in type of cropland.

Fig. 13 :- Percentage distribution of the volumes of different cereal crops produced by the sample HHs.



Source :- Sample survey, 1997/98

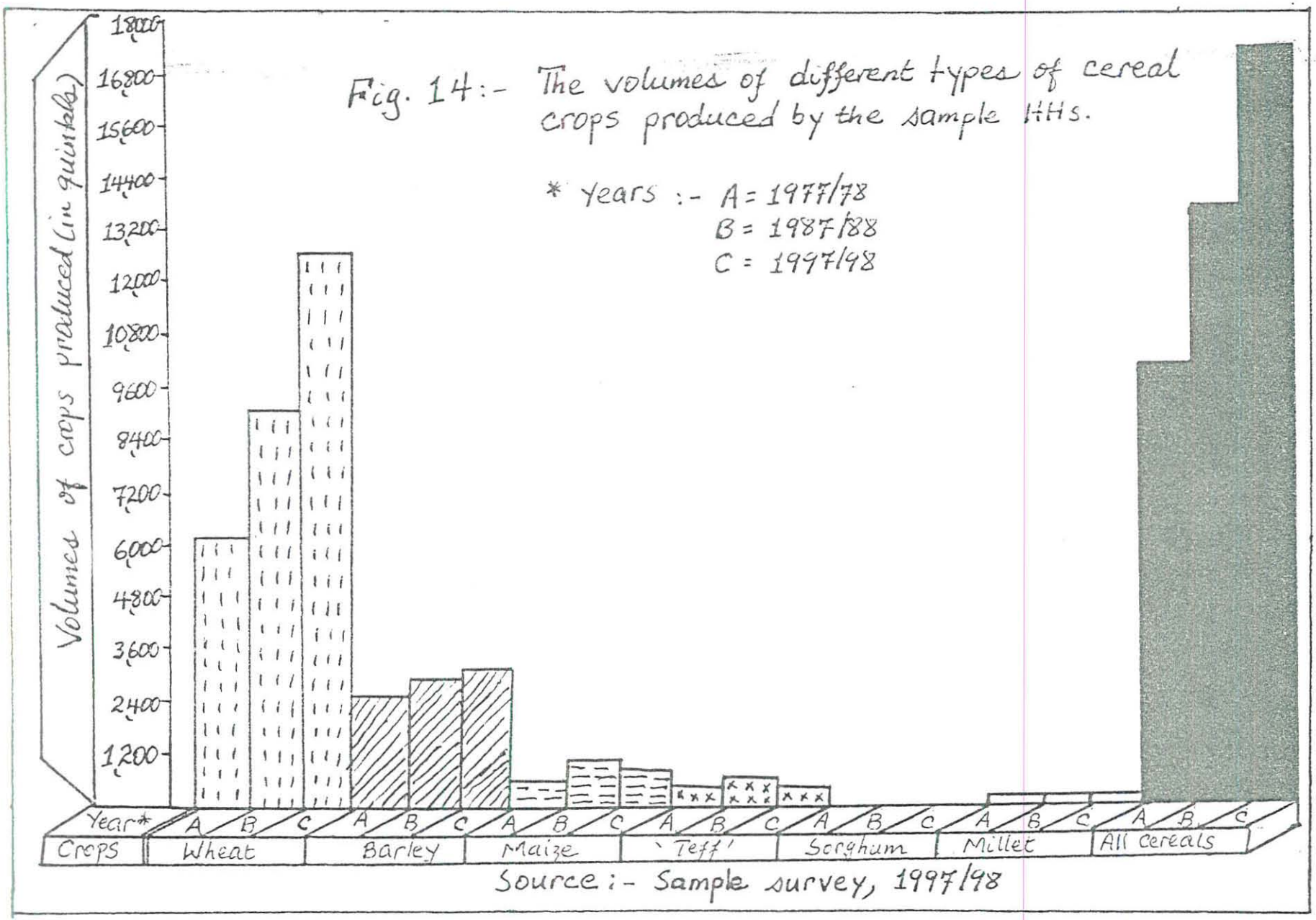


Fig. 14:- The volumes of different types of cereal crops produced by the sample HHs.

* Years :- A = 1977/78
B = 1987/88
C = 1997/98

Source :- Sample survey, 1997/98

Table 21:- Amounts of average yields by types of crops for 1977/78, 1987/88 and 1997/98.

Production years and indicators of changes		Crop yields per hectare (in quintals)			
		All crops	Cereal crops	Pulses	Oil seeds
Years	1977/78	26.0	26.4	22.9	21.7
	1987/88	29.0	29.5	24.7	29.1
	1997/98	33.6	34.1	25.1	32.6
1977/78 to 1997/98	Rate of change/year (%)	1.46	1.52	0.48	2.51
	Mean yield	29.5	30.1	24.2	27.8
	Range	7.6	8.0	2.2	10.9
	Standard Dev.	3.43	3.29	1.59	4.54
	C.V. (%)	11.6	10.9	6.6	16.3

Source: Sample survey, 1997/98.

Corresponding to the changes in cropland area, the total volumes of the production of crops increased at average rate of about 3.47% per year but the average amounts of the production of each of the sample HHs decreased from 42.8 quintals/household to 40.6 quintals/HH for cereals, from 7 quintals to 6.9 quintals for pulses and similarly for others. These changes can be associated with the growing changes of the population. The general pattern of productivity changes in the agricultural production practices of the peasant farmers can usefully be summerized in terms of a rural man as follows:-

$$\text{Mean production amount per a rural man (Y/L)} = \frac{\text{Total amount of crops produced by the sample HHs}}{\text{Total family sizes of the sample HHs}}$$

Table 22: Indicator of rural labour productivity, 1977/78, 1987/88 and 1997/98.

Year	Total number of the family members (L)	Total amount of the crops produced (in quintals) (Y)	Mean Out put per a rural man (Y/L)
1977/78	1002	10914.0	10.9
1987/88	1556	14724.0	9.5
1997/98	2212	18477.5	8.3
Mean	1590	14705.2	9.2

Source:- Sample survey, 1997/98.

The total family size of the sample HHs grew from 1002 to 2212 between 1977/78 and 1997/98 while the total amount of crops produced increased from 10914.0 quintals to 18477.5 quintals. Hence the average amount of output per a rural man decreased from 10.9 quintals in 1977/78 to 8.3 quintals in 1997/98. Therefore the mean labour productivity level of these three years became 9.2 quintals per a rural man. So, as the information indicates, the high and rapidly increasing rural people are engaging themselves on working over the available limited land asset that made the crop production practice of the peasant farmers to be labour intensive and the labour productivity of the peasants' decreased as a result of this rapid population growth under the condition of limited land resource and low use of modern inputs. That is why the current crop production practice of the peasant agriculture need to do much in its such character of labour intensive technique of production practice so as to promote this low and decreasing amount of labour productivity.

Therefore, under such conditions of unbalanced changes, in order to get an increased amount of food supply and to be sulf-sufficient in food production to raise the low labour productivity of the peasant farmer through raising the yields of crops becomes a necessary step.

CHAPTER SIX
HYPOTHESES TESTS AND MAJOR FINDINGS

6.1 HYPOTHESIS ONE

" Changes in agricultural land uses and cropping patterns have direct relations with population growth".

6.1.1. CHANGES IN AGRICULTURAL LAND USES

The detail analysis on the relation that existed between population growth and changes in different types of agricultural land uses has been presented in chapter three. As it can be referred to in the chapter therefore, cultivated lands (crop lands) have shown growth changes as the number of the rural population grows. On the other side, lands that were used for grazing (pastoral lands) and other minor land use types have shown decreasing changes in response to the growing population number. Therefore, it was on the basis of this understanding that the research intended to test for the degrees of changing relations that can be significantly observed between changes in the number of rural population and the areas of total holdings of the sample households, their cultivated lands, grazing lands and other minor land use types.

Hence, to test this hypothesis simple correlation/regression analysis is employed. In this analysis the total family size of the sample households is taken as independent variable (x) representing the changes in the number of rural population, while each of the total areas of all land use types (Y1), cultivated or croplands (Y2), grazing lands (Y3) and other minor land use types (Y4) of the sample households as observed through the years of 1977/78, 1987/88 and 1997/98. are taken as dependent variables and are evaluated separately. The result obtained in the simple correlation/regression analysis is presented in table 23 below.

Table 23: Results of simple correlation/regression analysis for changes in agricultural land uses.

Independent variable and the associated dependent variable	Simple corelation coefficient	Coefficient of determination 'r2'	% contribution to variance	'r' value at α level of significant	Level of significance	Degree of freedom
X↑Y1	0.9538	0.9097	90.9	0.128	1%	417
X↑Y2	0.9856	0.9714	97.1	0.128	1%	417
X↑Y3	-0.9828	0.9659	96.6	0.128	1%	417
X↑Y4	-0.6685	0.4469	44.7	0.128	1%	417

Source: Sample survey, 1997/98

(a) Changes in all types of agricultural land uses

The change in the total areas of all land use types of the 419 sample households is identified to have direct linear relation to changes in the number of their family members as indicated by the simple correlation coefficient of 0.9538 which is declared significant at the 1% significance level. This computed 'r' value indicates that about 91% of the total variation in the mean total area of all land use types is accounted by the linear function of the change in the family sizes of the households while about 9% of this variation is accounted by unexplained variables.

(b) Changes in cultivated land use

The total area of cultivated land of the sample households is identified to have positive and strong linear changing relations to the change in the number of the family members of the sample households as indicated by the simple linear correlation coefficient of 0.9856 which is significant at 1% level of significance. This computed 'r' value indicates that about 97.1% of the variation in the total area of cultivated land is accounted by the linear function of the change in the number of family members of the households and about 2.9% of the total variation is accounted by unexplained variables.

(C) Changes in grazing land use

The change in total area of grazing lands of the sample households is identified to have negative relation to the change in the number of their family members as observed through 1977/78 to 1997/98. This negative relation is indicated by the simple linear correlation coefficient (r) of -0.9828 which is significant at 1% significance level. According to the indication of this computed 'r' value, about 96.6% of the total variation in the total areas of grazing land use is accounted by the linear function of the change in the number of the family members of the sample households.

(d) Changes in other minor land use types

The total area of other minor land use types of the sample households is identified to have negative relation to the number of the family members of the sample households as indicated by the simple linear correlation coefficient (r) of -0.6685 which is significant at 1% significance level. This computed 'r' value indicated that about 44.7% of the total variation in the total area of minor land use types is accounted by the linear function of the change in the number of their family members.

Therefore hypothesis one which is "changes in agricultural land uses have direct relations with population growth" is tested to hold true and is significant at 1% level of significance.

However it has to be noted that these changes in the areas of different land use types (referred to above)in response to the growing changes of rural population number are limited to the availability of cultivable land asset of a given area. This happens due to the main fact that land being a limited natural resource which can not be stretched beyond its available area, population growth will result in increased density and more land will be used for cultivation until the available asset is completely utilized.

6.1.2. CHANGES IN CROPPING PATTERNS

The changes in the cropping patterns are seen with temporal changes as observed through 1977/78 to 1997/98. The reasons can be associated to the combined effects of natural, socio-cultural, demographic, economic and some other factors. However, this study mainly puts its

emphasis to the demographic factor specially growth in rural population size. In the assessment of the changes in the cropping patterns of the sample region, the variations in the proportions of the area coverage of each crop type, crop combinations, levels of crop specialization/diversification and crop concentration are computed.

On the Wereda level in 1977/78 the area of wheat accounted about 57.4%, barley 20.5%, beans 7.1%, maize 6.2%, teff 3.4%, peas 2.3% linseed 1.7%, millet 0.7% and sorghum 0.1% of the total cropland area. But in 1997/98 the area proportion of wheat increased and became 62.3% while the area proportions of barley, beans, maize, teff, peas, linseed, millet and sorghum decreased to 19.7%, 6.9%, 4.3%, 2.8%, 1.4%, 1.6%, 0.6%, and 0.1% respectively. The change in the proportion of area coverage of each cropland and the reasons are presented in chapter 5 (5.1) in pages 60 to 67 of this paper.

The importance of these area proportions of the crops at the levels of climatic zones appear to have slight difference. In the 'Dega' climatic zone the area proportions of barley, linseed and sorghum showed increasing change while of the other crops decreased from 1977/78 to 1997/98. On the other hand, the general pattern of area proportions the croplands of both the 'Weina Dega' and 'Kola' reflect similarity in distribution. With in each of these two zones the area proportion of wheat showed rapid increasing change while the area proportions of each of the other crops decreased in the last two decades. Therefore, the area of wheat shows a growing dominance over the other areas of croplands which have shown decreasing changes with in the 'Weina Dega' and 'Kola' and also in the 'Wereda' as a whole.

Table 24 : Crop combination indice

Climate Zone	Years	Crop Combination indice by numbers of crops									
		One Crop	Two crops	Three Crops	Four Crops	Five Crops	Six Crops	Seven Crops	Eight Crops	Nine Crops	Ten Crops
'Dega'	1977/78	4946	626	565	861	1082	1236	1421	1564	1683	1786
	1987/88	5232	682	465	797	1004	1176	1378	1540	1666	1772
	1997/98	5655	756	380	691	932	970	1324	1476	1596	1700
'Weina Dega'	1977/78	1340	1730	2213	2645	2968	3240	3457	3630	-	-
	1987/88	922	2282	2768	3277	3322	3875	4079	4252	-	-
	1997/98	939	1929	2778	3334	3691	3992	4213	4389	-	-
'Kola'	1977/78	2259	1119	1464	1764	2059	2322	2524	2689	-	-
	1987/88	1774	1514	1767	2144	2406	2721	2946	-	-	-
	1997/98	1159	1749	2471	2949	3279	-	-	-	-	-
All Zones	1977/78	2345	1035	1490	1765	2041	2261	2436	2592	2716	2825
	1987/88	1984	1244	1750	2009	2288	2524	2710	2861	2995	3086
	1997/98	1888	1148	1754	2188	2508	2762	2948	3108	3258	3348

Source : Sample survey, 1997/98

N.B :- The minimum value of crop combination index indicates the number of crops that most characterizes the area (zone).

Therefore, on the basis of area coverage of the crops the study area can be classed as two crops area where wheat and barley form the major composition of the wereda's crop combination . On zonal level, however, the 'Weinal Dega' and 'Kola' climati zones are mono crop areas with the dominance of wheat. But the 'Dega' zone is seen to be a three crops area where barley , wheat and beans are the most important crop combination (Table 24 above).

The average number of crops grown in the study area ranges from about 2.3 to 3.1 per household by forming an overall average of 2.6 per sample household (table 25 below).

Table 25 : Distribution of sample households by their respective numbers of crops cultivated.

	Number of crops cultivated/HH									
Climate zone	1	2	3	4	5	6	7	8	9	Mean number of crops grown
'Dega'	16 (10.4)	46 (29.9)	58 (37.7)	10 (6.5)	5 (3.2)	14 (9.1)	-	2 (1.3)	3 (1.9)	3.1
'Weina Dega'	98 (45.2)	46 (21.2)	31 (14.3)	8 (3.7)	27 (12.4)	-	5 (2.3)	2 (0.9)	-	2.3
'Kola'	17 (35.4)	13 (27.1)	6 (12.5)	3 (6.3)	9 (18.7	-	-	-	-	2.5
All Zones	131 (31.3)	105 (25.1)	95 (22.7)	21 (5)	41 (9.8)	14 (3.3)	5 (1.2)	4 (1)	3 (0.7)	2.6

Source:- Sample survey, 1997/98

* Figures in brackets indicate percentage values of the numbers of sample households.

As it is indicated on the table, more than three-fourth (about 79.1%) of the sample households grow upto three crops. This proportion for the sample farmers of the 'Dega' climatic zone is about 78%, for the 'Weina Dega' zone is about 80.7% and for the 'Kola' zone is about 75%. In the general cropping pattern of the sample households, the pesants that grow three to four crops are more concentrated in the "Dega' zone while for the 'Weina Dega' and 'Kola' they are more concentrated in the groups of crops that range from two to three in number. Therefore maximum number of crops are grown by the farmers of the "Dega' that grow upto 9 types and is followed by the farmers of "weina Dega' that grow upto 8 crops whereas the farmers of the 'Kola' grow only upto a maximum of 5 crops.

It was indicated earlier that in general the study area was classed as two crop combination region. However there is a significant spatial difference in the values of coefficients of specialization and of diversification (Table 26 below). The coefficient of specializtion (CS) i.e the degree of specialization or the level of diversification of agricultural activity which can be shown by comparing the percentage share of individual crops in the total cultivated area of the sample region by a unit area of the sampled peasant associations of each climatic zone (Bekure: 1983).

Thus the perecentage share of a given crop in a climatic zone is subtracted from the percentage share of area of the same crop in all sampled areas. All positive changes are added and then divided by 100. The index of CS ranges from 0 to 1. The higher the value of CS, the poor is the crop specialization and conversely the higher is crop diversification.

According to the indication of the coefficients of crop specialization (table 26) , in the 'Wereda' crop diversification level is generally low. On the other hand crop specialization is poor. However, there seems an apearance of a little change in this high diversification of crops i.e for an average index of 0.12 in 19977/78 changed to 0.18 in 1987/88 and then changed to 0.16 in 1997/98. Among the three climatic zones of the 'Wereda', it is in the 'Kola' zone that relatively highest level of crop specialization is observed and is followed by the 'Weina Dega' zone. The 'Dega' zone rather has relatively the highest level of crop diversification. Generally in the study area, there is no significant change in both the levels of crop specialization and diversification.

Table 26 : Difference in percentage shares of areas under different crops

Climate Zone	Years	Difference in % tage shares of areas under different crops									
		Wh.	**Ba.**	**Be.**	**Pe.**	**Ma.**	**Te.**	**So.**	**Li.**	**Mi.**	**Oth.**
'Dega"	1977/78	18.1	-11.9	-4.57	-1.77	4.9	-0.49	-0.13	-3.53	-0.22	-0.52
	1987/88	27.44	-19.07	-7.07	-1.71	6.13	-1.19	-0.13	3.53	0.01	-0.28
	1997/98	28.09	-15.48	-8.22	-2.54	3.41	-0.29	-0.37	-4.05	-0.18	0.39
'Weina Dega'	1977/78	-10.26	6.67	2.42	0.92	-2.31	0.32	-	-	0.07	0.38
	1987/88	-12.35	8.71	3.09	0.50	-2.11	0.76	-	-	-0.09	0.07
	1997/98	-11.17	6.08	3.74	0.88	-1.57	0.26	-	-	-0.04	0.12
'Kola'	1977/78	-1.02	0.70	0.66	0.82	-2.71	-0.07	-	-	0.22	-0.4
	1987/88	-2.43	2.50	1.15	1.55	-3.84	-1.07	-	-	0.47	-
	1997/98	-8.38	5.06	0.14	-	-0.28	-0.56	-	-	-	-

	Coefficient of crop specialization (CS)			
Year	'Dega'	'Weina Dega'	'Kola'	All zones
1977/78	0.23	0.11	0.02	0.12
1987/88	0.34	0.13	0.06	0.18
1997/98	0.32	0.11	0.05	0.16

Source :- Sample Survey, 1997/98

Wh = Wheat, Ba = Barley, Be = Beans, Pe = Peas,
Ma = Maize, Te = Teff, So = Sorghum, Li = Linseed, Mi = Millet, Oth = Others.

Table 27 : Degree of crops area concentration

Climate Zone	Years	Crop Combination indice									
		Wh.	Ba.	Be.	Pe.	Ma.	Te.	So.	Li.	Mi.	Oth.
'Dega"	1977/78	0.69	1.58	1.58	1.64	0.21	1.15	3.12	3.12	1.30	1.87
	1987/88	0.55	2.20	2.10	1.86	0.08	1.33	3.55	3.55	0.99	2.13
	1997/98	0.55	1.78	2.19	2.80	0.19	1.11	3.62	3.62	1.29	2.41
'Weina Dega'	1977/78	1.18	0.67	0.66	0.61	1.36	0.91	-	-	0.90	0.36
	1987/88	1.20	0.52	0.53	0.75	1.32	0.78	-	-	1.11	0.66
	1997/98	1.18	0.69	0.46	0.38	1.36	0.91	-	-	1.10	0.55
'Kola'	1977/78	1.02	0.97	0.90	0.66	1.43	1.02	-	-	0.69	1.67
	1987/88	1.04	0.86	0.83	0.21	1.58	1.30	-	-	0.47	-
	1997/98	1.13	0.74	0.98	-	1.06	1.20	-	-	-	-
All Zones	1977/78	0.96	1.07	1.07	0.96	1.00	1.03	3.12	3.12	0.96	1.30
	1987/88	0.93	1.19	1.15	0.94	0.99	1.14	3.55	3.55	0.86	1.40
	1997/98	0.95	1.07	1.21	1.59	0.87	1.07	3.62	3.62	1.20	1.48

Source : Sample ssurvey

Wh = Wheat, Ba = Berley, Be = Beans, Pe = Peas,

Ma = Maize, Te = Teff, So = Sorghum, Li = Linseed,

Mi = Millet, Oth = Others.

In agricultural activity of a given locality the level of crop concentration by the type of crop cultivated or the degree to which a particular crop is spatially localized can be expressed or measured by the use of crop concentration index (CCI) (Bekure, 1983). The degree of concentration of each crop type to specific climatic zone is generally insignificant in the study area except for sorghum and linseed that are seen moderately concentrated to the 'Dega' climatic zone of the 'Wereda' . In relative terms however barley, beans, and peas show moderate concentration to the 'Dega' climatic zone since the year 1987/88. Specially the beans and peas

have growing concentration changes to this zone. Wheat which occupies the largest areas of cultivated lands is grown in every climatic zone but it is relatively concentrated in a better degree to the 'Weina Dega' and 'Kola' zones.

Maize is also seen in better degree of concentration to the 'Weina Dega' and 'Kola ' zone. Generally major changes that can be observed in degrees of crop concentrations are low or insignificant except for barley , beans and peas through these study years.

6.2. HYPOTHESIS TWO

"There is significant variation in the use of modern farm machinery and farm inputs among the peasants of different climatic zones"

This hypothesis mainly refers to the variations existing among the peasants of the 'Dega', 'Weina Dega' and 'Kola' climatic zones in the amounts of the chemical fertilizers and improved seeds they used. It also refers to the differences among these farmers in their use of tractors and combiners. Therefore to test the significances of expected variations the writer used the data obtained through sample survey and are presented summerized in appendix 4,5,7 and 8. The model of analysis of variance with a single criteria for any number of groups with unequal usages (Steel and Torries; 1980) is emoloyed.

The detail analysis on the uses of chemical fertilizers and improved seeds by the sample households have been presented in chapter 5 (5.2.2) while their uses of tractors and cominers have been presented in chapter 4(4.2.2) above. The significances of variations expected in the use of chemical fertilizers and selected seeds are analysed on the basis of the diferences observed in amounts of the modern farm inputs used by different groups of sample households from each of the three climatic zones. The analysis of variation in the use of tractors is based on

the differences observed in farm areas that are cultivated by tractors by different groups of the sample households of each of the three climatic zones while the use of combiners is based on the differences observed in amounts of the crops harvested by combiners by different groups of the sample households. Each of these analyses of variances are conducted separtely and are presented as follows.

6.2.1. Use of chemical fertilizers

A total of 15 different groups of sample households were observed in the 'Dega', 'Weina Dega' and 'Kola' climatic zones for the different amounts of chemical fertilizers they used in 1987/88 (app. 7). Among this total, 5 groups of sample households who used different amounts of chemical fertilizer were from the 'Dega', 4 groups were from the 'Weina Dega' and the 6 groups were from the 'Kola' zones.

For the production year of 1997/98, a total of 8 groups of sample households who used different amounts of chemical fertilizers were reported. Out of this total 2 of them were reported from the 'Dega', 3 of them were from the 'Weina Dega' and 3 of them were reported from the 'Kola' zones. Hence the results of the significances of expected variations in the use of chemical fertilizers by the sample households of the three climatic zones for 1987/88 and 1997/98 are presented in table 28 below.

As it is indicated on the table the 'F' values computed for the analysis of variance are greater than the tabulated values at the levels of significances of 0.05 each with the degrees of freedom of 2 and 12 for 1987/88, and 2 and 5 for 1997/98. Therefore, it can be concluded that the variation in the use of chemical fertilizers by the sample households of different climatic zones is significant at 0.05 level of significance.

6.2.2. Use of selected seeds

According to the data obtained from the sample survey, in 1987/88 it was reported that 9 different groups of average amounts of selected seed was used by the sample households. From the total of the 9 groups, 4 were observed in the 'Dega', 3 were in the 'Weina Dega' and 2 were in the 'Kola' climatic zones. From the 'Dega' 29 sample households used a total of 32 quintals, from the 'Weina Dega' 22 sample households used a total of 30.5 quintals and from the 'Kola' 8 sample households used a total of 7 quintals in the year (app.8).

Table 28: Analysis of variance for the use of chemical fertilizers.

Production Year	Source of variation	Degree of freedom	Sum of squares	Mean squares	F Value		Level of signifi-cance
					Computed*	Tabular	
1987/88	Among locations	2	1856.27	928.14	5.00	3.88	0.05
	Within locations	12	2226.63	185.55			
	Total	14	4082.9				
1997/98	Among locations	2	2582.54	1291.27	6.05	5.79	0.05
	Within locations	5	1067.33	213.47			
	Total	7	3649.87				

Source:- Sample survey, 1997/98

In 1997/98 it was a total of 14 groups of average amounts of selected seeds that was used by the farmers. Among this total groups of averages 4 of them were from the 'Dega' (which hold 71 sample households who used 67.5 quintals together), 6 were from the 'Weina Dega' (which comprise 116 sample users who consumed a total of 166.5 quintals) and 4 were from the 'Kola' (comprise of 29 sample user who used a total of 35.5 quintals) zones (App. 8).

According to the indication of the result of this analysis of variance (table 29 below), the expected variation in the use of selected seed by the peasant farmers of different climatic zones is not statistically significant.

6.2.3. Use of tractors

The total tractor cultivated farm area of 42 sample households in 1987/88 was 47 hectares According to the information of the sample households who used tractor six different groups of tractor cultivated farm sizes were reported from the 'Weina Dega' and two were reported from the 'Kola' zones (app. 4).

Table 29: Analysis of variance for the use of selected seeds.

Year	Source of variation	D.F	Sum of squares	Mean squares	F value		L.S
					Computed	Tabulated	
1987/88	Among locations	2	53.86	26.93	2.34	5.14	NS*
	Within locations	6	69.2	11.53			
	Total	8	123.06				
1997/98	Among locations	2	886.62	443.31	1.37	3.98	NS*
	Within locations	11	3565.25	324.11			
	Total	13	4451.87	342.45			

Source:- Sample survey, 1997/98

NS* = Not significant

In 1997/98, the total area of tractor cultivated farms of 159 sample households was 156.75 hectares. From the 'Dega' zone it was only one group of area of tractor cultivated farms These tractor cultivated farm areas of the 'Weina Dega' were of five different groups in their sizes. From the 'Kola' zone five different groups of farm sizes was cultivated by tractors (app. 4).

Hence, the expected variation in the use of tractors by the peasant farmers of different climtic zones is not statistically significant for 1987/88. But for the production year of 1997/98, it is significant at 0.05 level of significance with 2 and 8 degrees of freedom (Table 30 below).

Table 30 :- Analysis of variance for use of tractors.

Year	Source of variation	Degree of freedom	Sum of squares	Mean squares	F Value		Level of significance
					Computed	Tabular	
1987/88	Among location	1	30.38	30.38	1.01	5.99	NS*
	Within location	6	179.88	29.98			
	Total	7	210.26				
1997/98	Among location	2	1119.97	559.99	4.47	4.46	0.05
	Within location	8	1003.00	125.38			
	Total	10	2122.97				

Source :- Sample survey, 1997/98

NS* = Not significant

6.2.4. Use of combiners

The variation in use of combiners is analizsed on the basis of the differences observed among the peasant farmers in their average amounts of crops harvested by the use of this modern farm machinery.

Therefore the total number of groups of observations reported was 7 out of which 5 were from 'Weina Dega' and 2 were from 'Kola' zones for 1987/88. While for 1997/98, a total of 10 observations were reported, out of which one was from the 'Dega', five were from the 'Weina Dega' and four were from the 'Kola' zones (App.5)

Table 31: Analysis of variance for the use of combiners.

Year	Source of variation	Degree of freedom	Sum of squares	Mean squares	F value		Level of significance
					Computed	Tabular	
1987/88	Among locations	1	59947.89	59947.89	2.45	6.61	NS*
	Within locations	5	122433.33	24486.67			
	Total	6	182381.22				
1997/98	Among locations	2	1478296.34	739148.17	2.09	4.74	NS*
	Within locations	7	2478780.19	354111.46			
	Total	9					

Source:- Sample survey, 1997/98
NS* = Not Significant.

According to the result obtained in this analysis of variance (table 31 above) the expected variation in the use of combiners among the peasant farmers of different climatic zones is not statistically significant.

Therefore, the general inference that can be made on these analyses of variances i.e the variances on the uses of chemical fertilizers, selected seeds, tractors and combiners is that significant variations are observed in the uses of chemical fertilizers and tractors whereas the expected variations in the uses of selected seeds and combiners are not statistically significant.

Accordingly, the second hypothesis "there is significant variation in the use of modern farm machinery and inputs among the peasants of different climatic zones" will have acceptance partially.

6.3. HYPOTHESIS THREE

" Access to required modern farm inputs and services at any time depends upon the farm income level of each peasant farmer".

The performance of farming activities is determined by natural and socio-economic, institutional and infrastructural elements including demographic variables (Maxwell, 1986;

Dayal, 1984). On the other hand Humphrey (1975) grouped these factors as production inputs of stock of land, labour and capital. Crop production capital inputs include biological and chemical fertilizers, selected seeds, the use of tractors and combiners etc.

Thus inorder to assess the patterns of use of modern inputs in the study area the average income levels of the sample households, (estimated in Birr), are considered as independent variable (x) while the average amounts of money spent, (estimated in Birr), on the use of modern inputs by the sample households are considered as dependent variables (y). These dependent variables are the various average expenditures of sample households on chemical fertilizers (y1), selected seeds (y2), tractors (y3) and combiners (y4). Simple correlation/regression analyses were employed for each of the dependent variables, i.e y1, y2, y3 and y4 and the independent variable (x) separately in order to assess the degrees of their dependency. Hence, when the use of chemical fertilizers (y1), selected seeds (y2), tractors (y3) and combiners (y4) are individually taken as dependent variables and correlated with the independent variable - average incomes of the respective user sample households (x) - the following results were obtained.

Table 32: Results of simple correlation/regression analysis for access to the use of modern farm inputs.

association of Independent and dependent variables	Simple corelation coefficient 'r'	Coefficient of determination 'r^2'	% contribution to variance	'r' value at level of significance	Level of significance	Degree of freedom
X↓Y1	0.9297	0.8434	84.3	0.148	1%	321
X↓Y2	0.9431	0.8894	88.9	0.181	1%	214
X↓Y3	0.9136	0.8347	83.5	0.208	1%	157
X↓Y4	0.9357	0.8755	87.6	0.208	1%	165
X↓Y (all types inputs)	0.9584	0.9185	91.9	0.128	1%	417

Source: Sample survey, 1997/98

As it is indicated on table 32 above, the separate associations show strong relations to the independent variable i.e average gross income levels of the sample households and each of the dependent variables - average expenditures of the sample households on each of the modern farm inputs viz, chemical fertilizers (y1), selected seeds (y2) tractors (y3) and combiners (y4) which are significant at 1% of level of significance each.

Generally in the overall association, a strong relation is observed in between the independent variable (income levels) and the dependent variable (average expenditures of the sample households on the use of the modern farm inputs) as indicated by the simple correlation coefficient of 0.9584. In this overall relationship 91.9% of the total variation is explained and is significant at 1% level of significance with 417 degrees of freedom.

On the other hand, this general association is also computed separately by considering the average gross expenditure of the sample households who used these modern inputs. This is due to the fact that some of the households used only chemical fertilizers (yA), while some others used both chemical fertilizers and selected seeds (yB), others used chemical fertilizers, selected seeds and combiners together (yC), others chemical fertilizers, and combiners and some of them used all of the four modern inputs (yD). The result of this simple correlation/regression analysis is presented in the following table.

Table 33: Results of simple correlation/regression analysis for access to each types of the modern farm inputs used by sample households.

associated dependent and independent variables	Simple corelation coefficient 'r'	Coefficient of determination 'r2'	% contribution to variance	'r' value at α-level of significance	Level of significance	Degree of freedom
X↑YA	0.3161	0.0999	9.99	0.302	1%	69
X↑YB	0.726	0.5271	52.7	0.283	1%	83
X↑YC	0.9715	0.9438	94.38	0.424	1%	34
X↑YD	0.9706	0.9421	94.2	0.228	1%	121
X↑Y (all types inputs)	0.9584	0.9185	91.9	0.148	1%	321

Source: Sample survey, 1997/98

The result obtained in these grouped associations show strong relationships between the independent variable (x) and the corresponding grouped dependent variable, i.e average total expenditure on the types of the used modern farm inputs except for those who used only chemical fertilizers which is relatively weak though positively correlated. Generally, as the results of

correlation coefficients indicate the degrees of strengths in the associations become stronger with the growth of both average incomes and average total expenditures of the sample households. The strongest degree of association is observed among the group of households whose average income levels range from Birr 8475 to Birr 11715 per household and spend average amounts of Birr 692 to Birr 1655 per household (refer to app. 12). In the opposite, the weakest degree of association is observed among the groups of households whose average incomes range from Birr 5235 per household to Birr 6045 per household and spend average amounts of Birr 243 to Birr 365 per household (app. 12).

Generally, strong relationship is observed between the independent variable (average income levels of the sample households) and the dependent variable (average total expenditures on the modern farm inputs of the sample households) as indicated by the simple correlation coefficient of 0.9584. This simple correlation coefficient and others which are computed for each of the different associations made (as presented on tables 32 and 33 above) are significant at 1% level of significances with their respective degrees of freedoms. Therefore, it can be concluded that the third hypothesis which is stated as "access to required modern farm inputs and services depends upon the farm income levels of each peasant farmer" holds true and has acceptance.

6.4. HYPOTHESIS FOUR

"Land and labour productivities of the traditional crop producing farms have increased significantly due to the increased use of modern farm machinery and inputs by the peasant farmers".

The performance of agricultural system can be evaluated interms of some of its activities such as its output or level of productivity. Accordingly some writers like (Wood, 1990; Markos, 1990; Taddesse, 1989) presented their views that Ethiopian agriculture is not able to feed its present population which means that its productivity level has either stagnated or declined.

Agricultural productivity, the outcome of mutually interacting forces of agrarian structure, land resources and technology (Singh, 1980) and the efficiency of use of inputs is a measure of agricultural performance (Dayal, 1984). When productivity is measured in relation to a particular input it is called partial productivity, while if it is measured in relation to all the

inputs taken together, it is referred to as total productivity (Hossain, 1974). As it is only the production of crops which is taken into account in determining agricultural productivity of the study area i.e 'Hitosa Wereda', it represents therefore the partial productivity.

In areas where labour and land are major inputs and land is scarce while labour is abundant; as in Bangladesh, India, etc... agricultural productivity is better measured in terms of both land and labour (Taddesse, 1989; Dayal, 1984). The same is true of the study area where land is relatively becoming scarce and population density is growing rapidly. In such area the possibility of expanding cropland area is limited, therefore an increased output can be achieved only by increasing other input factors.

Thus, the agricultural productivity of the study area is assessed by the help of land and labour productivity. The land productivity measures the average amount of crop produced per hectare of cultivated land area whereas labour productivity measures the average amount of crop that a farmer produces in return to his efforts. Gross average volume of crop harvested per hectare of cropland (in quintals) for all crops (which is referred to on table 21 in chapter 5 (5.4) is used as index of land productivity. It is considered in the respective simple and multiple correlation/regression analyses as dependent variable and denoted as (y1). On the other hand, the overall average amount of crops harvested by a rural labour (in quintals) which is presented on table 22 in chapter 5 (5.4) is used as indicator of labour productivity which is also considered in the statistical analysis as dependent variable and is denoted as (y2).

In case of the modern inputs used by the sample households viz. Chemical fertilizers and selected seeds, their respective total amounts that were used in 1977/78, 1987/88 and 1997/98 which are presented on tables 18 and 19 in chapter 5 (5.2.2.1. and 5.2.2.2.) respectively were taken as independent variables. In the analysis chemical fertilizers are denoted as x1 while selected seeds as x2. Regarding the use of modern farm machinery, Viz. tractors and combiners, it was the total areas of the tractor cultivated lands (in hectares) which is presented on app. 4 and the total amounts of combiner harvested crops (in quintals) which is presented on app. 5 for the respective production years of 1977/78, 1987/88 and 1997/98 that are considered as independent variables. In the statistical analysis, the tractor cultivated farm area of the sample households is denoted as (x3) while the amount of their combiner harvested crops is denoted as (x4).

6.4.1. LAND PRODUCTIVITY

When land productivity is taken as dependent variable and correlated with each of the independent variable i.e. chemical fertilizers used (x1), selected seeds used (x2), areas of tractor cultivated farms (x3) and combiner harvested crops (x4), by the use of simple correlation/regression model the following results were obtained (table 34 below).

The degrees of interdependence for each pair of associations can be regarded as strongly and positively correlated. Among the four selected independent variables the use of selected seed has the strongest possitive correlation and is followed by the use of combiners, tractors and chemical fertilizers, to the increasing changes in land productivity the dependent variable. In general each of the associations have direct and strong relations with the changes in land productivity in which each of them are significant at 1% level of significance.

Table 34: Simple correlation/regression results of land productivity and selected variables.

Explanatory variables	Simple correlation coefficient	Coefficient of determination 'r^2'	% contribution to variance	'r' value at α level of significance	Level of significance	Degree of freedom
X1	0.6736	0.4537	45.5	0.181	1%	215
X2	0.9322	0.869	86.9	0.260	1%	95
X3	0.8733	0.7627	76.3	0.302	1%	69
X4	0.8835	0.7806	78.1	0.292	1%	74

Source:- Sample survey, 1997/98

When these four selected explanatory variables are considered together and multiple correlation and regression analysis is run for it the result obtained is as follows.

Table 35:- Result of multiple correlation/regression analysis of land productivity and selected variables.

Explanatory variables	Regression coeff. 'B'	Standard error of 'B'	T ratio	Level of significance	Partial correlation coeff. 'r'	Coeff. Determin. 'r2'	% contribution to variance	F value	Level of significance
X1	0.53	19.715	11.52	0.01	0.6179	0.3818	38.2	839.55	1%
X2	1.39	419.36	2.11	0.2	0.9217	0.8495	85.0	17.57	1%
X3	1.44	375.215	2.24	0.2	0.8628	0.7444	74.4	19.46	1%
X4	1.42	373.755	2.25	0.2	0.8722	0.7607	76.1	19.55	1%
Y= 22.22+0.083x1+0.801x2-0.61x3+0.012x4									

Source:- Sample survey, 1997/98

The four selected explanatory variables considered here appeared significant and explained about 99.7% of the variance of land productivity (table 35 above). The unexplained variation by these variables accounted about 0.3% which is not significant at this level. The coefficient of determination of the multiple regression equation of these independent variables is 0.9967 and is significant at 1% level of significance. Therefore as the result of the multiple regression analysis indicates, the combined linear effects of each of the independent variables contribute significantly to the variation in land productivity.

6.4.2. LABOUR PRODUCTIVITY

As regards to the changes in labour productivity, the degrees of interdependance for each pair which are associated separately can be viewed as to have strong but negative correlation (table 36 below). According to the result of the computed simple correlation/regression analysis, among the four selected independent variables increased use of combiners has the strongest negative correlation with the decreasing change observed in labour productivity. The second independent variable which has strong negative correlation with change in labour productivity is the use of selected seeds followed by the uses of tractors and chemical fertilizers. Generally, the relationships are negative and strong and have significant associations with changes in labour productivity. Hence, the result obtained in this simple linear correlation analysis is opposite with what was anticipated in hypothesis four.

Table 36: Results of simple correlation/regression analysis of labour productivity and selected variables.

Explantory variables	Simple correlation coeff. 'r'	Coeff. of determination 'r^2'	% contribution to variance	'r' value at 1% level of significant	Level of signif.	Degree of freedom
X1	-0.8079	0.6527	65.3	0.181	1%	215
X2	-0.9184	0.8435	84.4	0.267	1%	95
X3	-0.9113	0.8305	83.1	0.302	1%	69
X4	-0.9192	0.8449	84.5	0.302	1%	74

Source:- Sample survey, 1997/98

In order to evaluate the combined effects of these four independent variables on changes in labour productivity multiple correlation/regression analysis was computed and the summary result is presented in table 37 below.

As indicated by the result of multiple correlation/regression analysis the combined effect of the four selected variables viz. the uses of chemical fertilizers, (x1). selected seeds (x2), tractors (x3) and combiners (x4) on changes in labour productivity appeared significant and explained about 91.5% of the total variation. The variations that are not explained by these variables account about 8.5% which has very small significance at this level.

Table 37: The results of multiple of correlation/regression analysis of labour productivity and selected variables.

Explanatory variables	Regression coeff. 'B'	Standard error of 'B'	T ratio	Level of significance	Partial correlattion coeff. 'r'	Coeff. Determ. r^2	% contribution to variance	F value	Level of significance
X1	-0.014	0.121	16.02	0.001	0.8475	0.7183	71.8	70.05	1%
X2	-0.009	0.7266	2.90	0.01	0.4464	0.1993	19.9	9.452	1%
X3	-0.016	0.920	2.74	0.012	0.5434	0.2953	29.5	6.897	5%
X4	-0005	0.9345	2.86	0.012	0.4351	0.1893	18.9	6.754	5%
Y=12.5-0.03x1+0.31x2-0.29x3-0.11x4									

Source: Sample survey, 1997/98

The coefficient of determination (r^2) of the multiple regression equation of these independent variables is 0.9148 and is found significant at 5% level of significance. Therefore, the combined linear effects of each of the independent variables have significant negative contribution to the variation in labour productivity.

Hence, it can be concluded that the increased use of modern farm machinery (in this case tractors and combiners) and modern inputs (chemical fertilizers and selected seeds) by the peasant farmers have significant contribution to the growth of land productivities of the traditional crop producing farms. On the other hand the labour productivities decreased significantly although the peasant farmers' use of modern farm inputs increased. Thus, hypothesis four which is stated as "land and labour productivities of the traditional crop producing farms have increased significantly due to the increased use of modern farm machinery and inputs by the peasant farmers" will have acceptance only partially.

Population growth therefore, has positive influence upon land productivity and negative influence upon labour productivity. This implication has strong relation to Boserup's assertion of growth in population leads to intensification which is followed by dimunition of land holding sizes, which leads to the necessity of increased uses of inputs such as fertilizers, improved technology, pesticides, weed killer chemicals etc.... According to Boserup, a positive relationship exists between population density on one hand frequency of cultivation and level of technology on the other hand. What she implied was that if intensification was associated with increased agricultural inputs including technology, the result would be rise in land productivity. In this respect then, population density and land productivity show positive association (Boserup, 1965). Thus according to Boserup's stand, without change in technology and inputs used population increase may not result in increase of land productivity and may have an opposite effect (Dayal, 1984). The correlation and regression results presented in tables 34 and 35 have strong relation to Boserup's assertion.

According to the result obtained, the sample households who used each of the modern inputs have increased in response to the growing number of the rural population. All of the associations made are strongly correlated and are significant at 1% level of significance. Strongest relation is observed among the sample households who used chemical fertilizers followed by the combiners, selected seeds and tractors users.

The major reasons for strong associations are related to the results of population growth - i.e. increase in population density that leads to intensification as a result of dimunition of land holding sizes which in turn leads to the necessity of increased uses of farm inputs (refer to chapter 6.4 above). In the study area, because of the increasing changes in population density average land holding sizes decreased significantly (chapter 3 (3.2)). Due to this reason the farms are repeatedly cultivated and their soil fertility is reduced. As a result therefore the amounts of productions and productivities of the peasants are lowered. In addition to these problems the number of farm animals per household are decreased due to the problem of scarcity of the grazing lands and also the power producing or working capacities of the animals are reduced. Therefore, such problems contributed negative influences to the productivity levels of the farmers. Hence these major reasons necessitated the peasant farmers for the increased need for the use of the modern farm inputs. Besides these major reasons, the positive contributions of chemical fertilizers, selected seeds (due to their high yield), tractors and combiners (because of their working efficiencies) to the improvements of levels of productions and productivities have to be considered.

SUMMARY AND RECOMMENDATIONS

SUMMARY

Hitosa 'Wereda' or the study area is found in the central part of Ethiopia in Oromiya region by occupying the northern part of Arsi zone. It comprises of the 'Dega', 'Weina Dega' and 'Kola' climatic zones. Its total population was estimated at 174360 out of which about 88% are rural. The 'Wereda' has 28869 peasant households organized under 37 PAs and the average family size is 5.31 members/HH. The rural settlement pattern is found mainly in scattered form.

It was 11 PAs (30% of the total number of the PAs of the three climatic zones) and 419 households (5% of the total number of the households of the selected sample PAs) that were taken as samples. 85.2% of the sample households are accounted for male and 14.8% are female.

As regards the land use pattern, 86.9% is accounted for cultivated lands, 5.6% for grazing lands and 7.5% for other land use types in 1997/98. Fallowing is almost abandoned and is not significant in the region.

About 73.8% of the sample households owned land holding sizes of less or equal to 2.00 hectares while about 26.2% of them owned holding sizes of 2.01 upto 4.00 hectares. The average holding size of a sample household was 1.51 hectares and the median size computed was 1.48 hectares.

Because the major unit of labour of production and consumption is the family of the peasant household, the family labour is the basis of all farm operations.

In the study area the activity of crop production is performed under mixed farming and the animals raised mainly serve as sources of draft power. Therefore, the oxen power is most important for cultivation and the equines for transport purpose.

The major types of farm tools used by the peasant farmers of the study area are similar in type and are mainly traditional, archaic and simple. They also use modern farm machinery (tractors and combiners). It was identified that the number of modern farm machinery user households, tractor cultivated farm areas and combiner harvested volumes of crops have shown increasing changes in the last two decades. However the diminution in farm sizes, land fragmentations, the high and increasing service costs of the machinery and their scarcity in supply and poor development of rural infrastructure were reported as the major problems of the sample households in their use of these machinery.

The cropping pattern of the study area was found to be dominated by the area under cereal crops which covered about 89.9% while the pulses and oil seeds covered about 8.3% and 1.5% of the total area of croplands respectively in 1997/98. Currently, the majority of the peasant households grow four main crops viz. wheat, barley, maize and 'teff'. The average number of crops grown in the area was identified as 2.6. But it was 3.1 in 'Dega', 2.3 in 'Weina Dega' and 2.5 in 'Kola' climatic zones.

The peasant farmers use mainly traditional methods to maintain soil fertility and soil problems. They practice contour plowing and terracing to control soil erosion and crop rotation to maintain the fertility of their farms.

The farmers use also chemical fertilizers and selected seeds to improve their production and productivity levels. In the study area the number of sample households who make use of chemical fertilizers and selected seeds, the amounts of these inputs used and the rates of applications of these inputs have shown significant growth changes through the last twenty years. However, variations are observed among the user households of different climatic zones in the use of these inputs.

The production of cereal crops dominated the others and accounted for about 92.1% of the pulses 6.2% and of the oil seeds 1.5% of the total volumes of crops produced by the sample households in 1997/98. The five most important crops in their amounts produced in the study area were wheat, barley, beans, maize and 'teff'. These crops accounted for 69.1%, 16.8%, 5.2%, 3.7% and 2.0% of the total volume of crops produced in 1997/98 respectively. As it is indicated by the sample households their average crop production amounts have decreased by about 7.6% since 1977/78.

The crops produced by the sample households are mainly food crops. Among these crops, wheat is the major crop which is produced in surplus amount by most of the peasants and is marketable for their cash needs. Besides wheat; barley, beans, peas, linseeds, maize and 'teff' are also marketed. It was found that in 1997/98 about 11.5% of the sample households earned 100% of their cash needs only from the selling of these crops and 76.4% of them earned an average of 96.5% of their incomes in this way.

As livestock is the other component that support the people of the study area, it was found that the total number of the livestock raised have increased while the average number have decreased. The increases of the total number of the livestock raised may be attributed to the

growth change in the number of households who raise their own farm animal while the decrease in the average number of the livestock may be associated to the decreasing change in the average sizes of grazing land holdings of the raiser households. The farm animals and their products provided a mean of 4% of the average income earnings for about 76.4% of the sample households in 1997/98.

In the study area, it was identified that the labour productivity decreased by 23.9% while the land productivity increased by about 29.2% through the study periods of 1977/78 and 1997/98. The decreasing change in labour productivity can be attributed to the decrease in average areas of land holdings, rapid growth of population and changes in natural elements such as climatic elements, natural fertility of soils, etc. The increasing change in land productivity can be associated to the positive contributions of increased use of modern farm inputs and also favourable climate.

According to the results obtained from the computed values of the correlation/regression analyses, it was identified that

(1) Strong and positive changing relations in between the changes in the total areas of all land use types and total areas of cultivated lands to changes in the number of rural population.

(2) Negative changing relations in between the changes in

  (a) total areas of grazing lands and other minor land use types to the changes in rural population.

  (b) labour productivity and use of modern farm inputs

The results obtained from the analyses of variance computed for the significances of the expected variations in the use of modern machinery and inputs among the peasants of different climatic zones confirmed the presence of significant variation in the use of chemical fertilizers and tractors; and the absence of significant variation in the use of selected seeds and combiners among the peasant farmers of different climatic zones.

The identified results of correlation/regression analyses provide some support to the theoretical propositions of Boserup's theory of 'agrarian change', which was asserted as growth in population leads to intensification which is followed by diminution of land holding sizes which inturn necessitates increased use of inputs such as fertilizers, improved technology,

pesticides, weed killer chemicals, etc. She admitted that population increase if associated with rise in agricultural inputs can result in an increase in agricultural productivity. Otherwise productivity could suffer. (Boserup, 1965).

Likewise, since the farming system in the study area is traditional type but experiencing increased use of modern farm inputs and technology, population growth appeared to have positive relation to land productivity. This supports what Boserup suggested as a positive correlation of population increase and land productivity under the condition of increased use of farm inputs. In similar situation, the negative correlation result identified in the relations between increases in rural population and labour productivity is also related to Boserup's arguement, that is, output per worker is more likely to decline than increase when labour input is raised (Boserup, 1965).

RECOMMENDATION

In order to promote the rural living by improving the low average production level which necessitates to improve the land use and restructure the farming system should be mainly focussed. In light of the problems so far noted, therefore, as solution the following are recommended.

(1) The primary measure to be considered should be how to promote the low average production level of a peasant household which is observed to be affected by the diminution in average farm sizes and by the type of the agricultural practice.

(2) The simple and traditional tools employed have negative contribution to improvements in productivity. In their efforts, the peasant farmers have to be supported and initiated to make use of modern farm inputs and machinery. Therefore, it is important and helpful to

   (a) assist the peasants to improve their income levels and raise their investing capacities by providing them with long term credit and loan services.

   (b) organize the rural households in producer organizations and in credit associations so as to improve the problem of farm land fragmentations and strengthen their capacities of savings and investings.

(c) study and search for some feasible mechanisms in which the high and increasing market prices of the modern farm inputs could be kept in a balanced position with the affording capacities of the peasant farmers. The MOA or any responsible body should seek some better ways of improving the supplying methods of the services of the modern farm machinery and/or regulate their service costs.

(3) The dependence on natural grazings need to be complemented with animal feed that can be produced by the farmers and also the land use system need to be optimally planned by balancing the demand for different uses.

(4) Because the development of infrastructure facilitates the supply of agricultural inputs, the easily marketing of the surplus produced and also improves the availability of credit services, etc... the rural infrastructure and services should be extended and/or developed.

(5) There should be strong integration between the crop production practice and other occupational or income generating activities. Local and other investments should be attracted towards the area and establish small and medium scale agricultural products processing industries which make use of the locally available products and raw materials.

(6) The agricultural researches should mainly be farmers based and also be that would help the improvement of the traditional crop production technology.

(7) Agricultural training and extension services should be intensified as they are important to transform the traditional agriculture.

(8) The peasant farmers of the area should be advised, supported and educated to employ improved and appropriate soil, water and natural vegetation conservation measures. The provision of environmental education would have important contribution in this respect.

(9) Both the federal and regional governments and their agencies including NGOs may persue the options of warranting capital investment towards the development of small and medium scale irrigation schemes in the area.

(10) It is unquestionable to keep balance between population and the available economic resources through either controlling the current fast population growth rate or developing the production volumes to the level of population growth rate. Therefore, the national population policy should be strictly observed, the services of education and health including family planning be provided, improved and expanded.

All these measures, if pursued rationally would facilitate the efforts of the peasant farmers to promote their average production levels, improve their living conditions, develop and transform the traditional agricultural production system. Finally would contribute considerably to keep balance between the supply and demand of food in the area as well in the country.

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Appendix 1

Age structure of sample households

Climatic zone	'Dega'		'Weina Dega'		' Kola'		All zones	
Sample HHs / Age group (in years)	No.	%	No.	%	No.	%	No.	%
20-29	11	7.1	40	18.4	7	14.6	58	13.8
30-39	41	26.6	63	29.1	17	35.4	121	28.9
40-49	49	31.8	64	29.5	16	33.3	129	30.8
50-59	36	23.4	30	13.8	5	10.4	71	16.9
60 and above	17	11.1	20	9.2	3	6.3	40	9.6
Total	154	100.0	217	100.0	48	100.0	419	100.0

Source:- Sample survey, 1997/98

Appendix 2

Land holding sizes (ha.) of the HHs

Land holding sizes (in ha.)	1977/78			1987/88			1997/98		
	HHs		Holding sizes (ha.)	HHs		Holding size (ha.)	HHs		Holding size (ha.)
	No	%		No.	%		No.	%	
≤ 1.00	13	5.7	6.5	41	12.6	20.5	116	27.7	58.0
1.01 - 2.00	76	33.2	114.0	154	47.1	231.0	193	46.1	289.5
2.01 - 3.00	95	41.5	237.5	108	33.0	270.0	99	23.6	247.5
3.01 - 4.00	30	13.1	105.0	24	7.3	84.0	11	2.6	38.5
4.01 - 5.00	15	6.5	67.5	-	-	-	-	-	-
Total	229	100.0	530.5	327	100.0	605.5	419	100.0	633.5
Av. Holding/HH			2.32			1.85			1.51
St. Dev.			0.95			0.80			0.79
C.V. (%)			41.0			43.2			52.3

Source:- Sample survey, 1997/98

Appendix 3

Major Land Use types of the sample holders

Year	Land use types	'Dega'				' Weina Dega '				' Kola '				All zones			
		Holders		Holding sizes (ha)		Holders		Holding sizes (ha)		Holders		Holding sizes (ha)		Holders		Holding sizes (ha)	
		No.	%	Size	Av/HH	No.	%	Size	Av/HH	No.	%	Size	Av/HH	No.	%	Size	Av/HH
1977/78	Cultivated	89	100.0	135.0	1.52	1.12	100.0	235.0	2.10	28	100.0	50.5	1.80	229	100.0	240.5	1.84
	Grazing	72	80.9	23.5	0.33	92	82.1	31.0	0.34	19	67.9	4.75	0.25	18.3	79.9	59.25	0.32
	others	17	19.1	18.0	1.06	20	17.9	28.0	1.40	9	32.1	4.75	0.53	46	20.1	50.75	1.10
	Total	89	100.0	177.5	1.98	112	100.0	294.0	2.62	28	100.0	60.0	2.14	229	100.0	530.5	2.32
1987/88	Cultivated	125	100.0	142.5	1.14	160	100.0	305.0	1.91	42	100.0	59.5	1.42	327	100.0	507.0	1.55
	Grazing	82	65.6	22.5	0.27	92	57.5	25.5	0.28	17	40.5	4.25	0.25	191	58.4	52.25	0.27
	others	43	34.4	21.5	0.50	68	42.5	23.5	0.35	25	59.5	1.25	0.05	136	41.6	46.25	0.34
	Total	125	100.0	186.5	1.49	160	100.0	254.0	2.21	42	100.0	1.55	100.0	327	100.0	605.25	1.85
1997/98	Cultivated	154	100.0	152.0	0.99	217	100.0	331.75	1.53	48	100.0	66.5	1.39	419	100	550.25	1.31
	Grazing	68	44.2	17.5	0.26	59	27.2	14.75	0.25	14	29.2	3.5	0.25	141	33.7	35.75	0.25
	others	86	55.8	26.5	0.31	158	72.8	20.0	0.13	34	70.8	1.00	0.03	278	66.3	47.5	0.17
	Total	154	100.0	198.0	1.27	217	100.0	366.5	1.69	48	100.0	71.00	1.48	419	100.0	633.5	1.51

Source :- Sample survey, 1997/98

Appendix 4
Distribution of tractor cultivated farm areas (ha.) And tractor user sample HHs

Climatic zones	Tractor cultivated farm sizes of the HHs.	1977/78		1987/88		1997/98	
		No. of HHs	Total area of tractor cultivated (ha.)	No. of HHs	Total area of tractor cultivated (ha.)	No. of HHs	Total area of tractor cultivated (ha.)
	0.75	-	-	-	-	3	2.25
	1.25	-	-	-	-	-	-
	Total	-	-	-	-	3	2.25
	%	-	-	-	-	1.95	1.49
	Av. area/HH	-	-	-	-	-	0.75
'Weina Dega'	0.25	2	0.50	6	1.50	23	5.75
	0.75	2	1.50	13	9.75	48	36.00
	1.25	3	3.75	3	3.75	23	28.75
	1.75	2	3.50	10	17.50	27	42.25
	2.25	2	4.50	3	6.75	6	13.50
	2.75	-	-	1	2.75	-	-
	Total	11	13.75	36	42.00	127	126.25
	%	9.82	5.85	22.5	13.8	58.5	38.1
	Av. Area/HH	-	1.25	-	1.17	-	0.99
'Kola'	0.25	-	-	-	-	4	1.00
	0.75	-	-	5	3.75	16	12.00
	1.25	-	-	1	1.25	4	5.00
	1.75	-	-	-	-	2	3.50
	2.25	-	-	-	-	3	6.75
	Total	-	-	6	5.00	29	28.25
	%	-	-	14.29	8.40	60.4	42.2
	Av. Area/HH	-	-	-	0.83	-	0.97

All zones	0.25	2	0.50	6	1.50	27	6.75
	0.75	2	1.50	18	13.50	67	50.25
	1.25	3	3.75	4	5.00	27	33.75
	1.75	2	3.50	10	17.50	29	45.75
	2.25	2	4.50	3	6.75	9	20.25
	2.75	-	-	1	2.75	-	-
	Total	11	13.75	42	47.00	159	156.75
	%	4.80	3.27	12.80	9.27	37.95	28.5
	Av. Area/HH	-	1.25	-	1.12	-	0.99

Source:- Sample survey, 1997/98

Appendix 5
Distribution of volumes of combiner harvested crops and combiner user sample HHs

Climatic zones	Amounts of combiner harvested crops by HHs. (Quintals)	1977/78		1987/88		1997/98	
		A	B	A	B	A	B
'Dega'	10.5	-	-	-	-	3	31.5
	Total	-	-	-	-	3	3.15
	%	-	-	-	-	1.95	-
	Av. amount/HH	-	-	-	-	-	10.5
'Weina Dega'	10.5	4	42.00	13	136.5	29	304.5
	30.5	2	61.0	8	549.0	69	2104.5
	50.5	2	101.0	6	303.0	26	1313.0
	70.5	2	141.0	2	141.0	7	493.5
	90.5	-	-	2	181.0	4	362.0
	Total	10	345.0	41	1310.5	135	4577.5
	%	8.93		25.6		62.2	
	Av. Amount/HH		34.5		31.967		33.9
'Kola'	10.5	-	-	8	84.0	13	136.5
	30.5	-	-	1	30.5	12	366.0
	50.5	-	-	-	-	3	151.5
	70.5	-	-	-	-	1	70.5
	Total	-	-	9	114.50	29	724.5
	%	-	-	21.4		60.4	
	Av. Amount/HH	-	-		12.72		25.0
All zones	10.5	4	42.0	21	220.5	45	472.5
	30.5	2	61.0	19	579.5	81	2470.5
	50.5	2	101.0	6	303.0	29	1464.5
	70.5	2	141.0	2	141.0	8	564.0
	90.5	-	-	2	181.0	4	362.0
	Total	10	345.0	50	1425.0	167	5333.5
	%	4.37	3.2	15.3	9.7	39.9	28.9
	Av. Amount/HH		34.5		28.5		31.9

Source:- Sample survey, 1997/98

A= No. Of HHs B= Total amount of combiner harvested crops

Appendix 6

Cropland areas under major types of crops and producer sample HHs

Crop types		1977/78				1987/88				1997/98			
		Producer sample HHs	Cropland		Av. Area Per HH (ha.)	Producer sample HHs	Cropland		Av. Area Per HH (ha.)	Producer sample HHs	Cropland		Av. Area Per HH (ha.)
		No	Area (ha.)	%		No	Area (ha.)	%		No	Area (ha.)	%	
Cereal Crops	Wheat	218	241.5	57.4	1.11	313	307.25	60.6	0.98	399	342.75	62.3	0.86
	Barley	193	86.25	2.5	0.45	242	91.50	18.0	0.38	296	108.50	19.7	0.37
	Maize	85	26.25	6.2	0.31	115	33.75	6.7	0.29	90	23.50	4.3	0.26
	'Teff'	55	14.25	3.4	0.26	60	18.00	3.6	0.30	62	15.50	2.8	0.25
	Sorghum	1	0.25	0.1	0.25	1	0.25	0.1	0.25	3	0.75	0.1	0.25
	Millet	12	3.00	0.7	0.25	14	4.50	0.9	0.25	12	3.50	0.6	0.29
	All cereals	229	371.50	88.3	1.62	327	455.25	89.8	1.39	419	494.5	89.9	1.18
Pulses	Beans	114	30.00	7.1	0.26	134	33.5	6.6	0.25	152	38.00	6.9	0.25
	Peas	36	9.50	2.3	0.26	36	10.0	2.0	0.28	31	7.75	1.4	0.25
	All pulses	129	39.50	9.4	0.31	154	43.50	8.6	0.28	165	45.75	8.3	0.28
	Oil seeds	24	7.00	1.7	0.29	28	7.00	1.4	0.25	34	8.50	1.50	0.25
	Others	10	2.50	0.6	0.25	5	1.25	0.2	0.25	6	1.50	0.30	0.25
	All crops	229	420.5	100.0	1.84	327	507.0	100.0	1.55	419	550.25	100.0	1.31

Source : Sample survey, 1997/98

Appendix 7
Amounts of chemical fertilizers used by sample HHs of different climatic zones

Year	Different amounts used (quintals)	'Dega'		'Weina Dega'		' Kola'		All zones	
		User HHs	Amount used	User HHs	Amount used	User HHs	Amount used	User HHs	Amoun t used
1977/78	0.5	12	6.0	8	4.0	1	0.5	21	10.5
	1.0	26	26.0	27	27.0	5	5.0	58	58.0
	1.5	1	1.5	4	6.0	3	4.5	8	12.0
	2.0	6	12.0	8	16.0	2	4.0	16	32.0
	2.5	1	2.5	-	-	1	2.5	2	5.0
	3.0	2	6.0	1	3.0	1	3.0	4	12.0
	Total	48	54.0	48	56.0	13	19.5	109	129.5
	Av.amount per HH		1.13		1.17		1.5		1.19
	Av.amount per ha.		0.85		0.62		0.81		0.73
1987/88	0.5	23	11.5	17	8.5	4	2.0	44	22.0
	1.0	44	44.0	37	37.0	7	7.0	88	88.0
	1.5	7	10.5	23	34.5	5	7.5	35	52.5
	2.0	14	28.0	28	56.0	5	10.0	47	94.0
	2.5	2	5.0	-	-	1	2.5	3	7.5
	3.0	-	-	-	-	3	9.0	3	9.0
	Total	90	99.0	105	136.0	25	38.0	220	273.0
	Av.amount per HH		1.10		1.30		1.52		1.24
	Av.amount per ha.		0.89		0.81		0.87		0.85
1997/98	0.5	56	28.0	82	41.0	18	9.0	156	78.0
	1.0	58	58.0	68	68.0	13	13.0	139	139.0
	1.5	-	-	24	36.0	4	6.0	28	42.0
	Total	114	86.0	174	145.0	35	28.0	323	259.0
	Av.amount per HH		0.75		0.83		0.80		0.80
	Av.amount per ha.		0.77		0.79		0.76		0.79

Source:- Sample survey, 1997/98

Appendix 8

Amounts of selected seeds used by sample HHs of different climatic zones

Year	Different amounts used (quintals)	'Dega'		'Weina Dega'		'Kola'		All zones	
		User HHs	Amount used	User HHs	Amount used	User HHs	Amount used	User HHs	Amount used
1977/78	0.5	-	-	1	0.5	1	0.5	2	1.0
	1.0	1	1.0	4	4.0	3	3.0	8	8.0
	1.5	1	1.5	2	3.0	-	-	3	4.5
	2.0	1	2.0	1	2.0	-	-	2	4.0
	Total	3	4.5	8	9.5	4	3.5	15	17.5
	Av.amount per HH.		1.5		1.19		0.88		1.17
	Av.amount per ha.		1.38		1.36		2.33		1.49
1987/88	0.5	7	3.5	-	-	2	1.0	9	4.5
	1.0	13	13.0	11	11.0	6	6.0	30	30.0
	1.5	5	7.5	5	7.5	-	-	10	15.0
	2.0	4	8.0	6	12.0	-	-	10	20.0
	2.5	-	-	-	-	-	-	-	-
	Total	29	32.0	22	30.5	8	7.0	59	69.5
	Av.amount per HH		1.10		1.39		0.88		1.18
	Av.amount per ha		1.58		1.45		2.0		1.55
1997/98	0.5	18	9.0	8	4.0	5	2.5	31	15.5
	1.0	44	44.0	55	55.0	10	10.0	109	109.0
	1.5	7	10.5	13	19.5	10	15.0	30	45.0
	2.0	2	4.0	28	56.0	4	8.0	34	68.0
	2.5	-	-	8	20.0	-	-	8	20.0
	3.0	-	-	4	12.0	-	-	4	12.0
	Total	71	67.5	116	166.6	29	35.5	216	269.5
	Av.amount per HH		0.95		1.44		1.22		1.25
	Av.amount per ha.		1.86		1.62		1.63		1.67

Source: Sample survey, 1997/98

Appendix 9

Distribution of sample households by the amounts of crops they harvested

Amounts of crops produced per sample HH (in quintals)	1977/78		1987/88		1997/98	
	Producer sample HHs		Producer sample HHs		Producer sample HHs	
	No.	%	No.	%	No.	%
1-10	43	18.8	59	18.0	68	16.2
11-20	72	31.4	91	27.8	99	23.6
21-30	35	15.3	30	9.2	27	6.4
31-40	31	13.5	56	17.1	59	14.1
41-50	24	10.5	53	16.2	77	18.4
51-60	12	5.2	22	6.7	53	12.7
61-70	7	3.1	4	1.2	19	4.5
71-80	5	2.2	8	2.5	7	1.7
81-90	-	-	4	1.2	10	2.4
Total	229	100.0	327	100.0	419	100.0

Source:- Sample survey, 1997/98

Appendix 10

Average farm income earning of sample HHs by major sources.

No.	Sample HHs.		Av. income earning/HH by headings (in Birr)									
			Cropsell		Animals & their products		Sideline activity		Human labour		Gross av. income	
	No.	%	income	%	income	%	income	%	income	%	income	%
1	5		2755		–		730		130		3615	
	2		2735		–		730		150		3615	
	4		2715		–		730		170		3615	
	5		2955		–		550		110		3615	
	2		3785		–		550		90		4425	
	3		3965		–		350		110		4425	
Sub	4		4145		–		150		130		4425	
" total	25	6.0										
" mean			3237	82.9	–	–	541.2	13.8	128.4	3.3	3906.6	100.0
2	22	5.3	4355	98.4	–	–	–	–	70	1.6	4425	100.0
3	28		5235		–		–		–		5235	
	11		6045		–		–		–		6045	
	4		7665		–		–		–		7665	
Sub	5		8475		–		–		–		8475	
" total	48	11.5										
" mean			5960.6	100.0	–	–	–	–	–	–	5960.6	100.0
4	19		5135		100						5235	
	27		5085		150						5235	
	42		5845		200						6045	
	26		6630		225						6855	
	21		7365		300						7665	
	32		7315		350						7665	
	20		7415		250						7665	
	20		8100		375						8475	
	22		8860		425						9285	
	12		8885		400						9285	
	21		9645		450						10095	
	6		10405		500						10905	
	11		10385		525						10905	
	14		11165		550						11715	
	14		11950		575						12525	
	8		12735		600						13335	
	3		13495		650						14145	
	1		14305		650						14955	
	2		16710		675						17385	
	1		17520		675						18195	
	1		18305		700						19005	
Sub	1		19115		700						19815	
" total	324	77.3										
" mean			8028.3	96.0	336.9	4.0					8365.2	100.0
Grand total	419	100.0										
Grand mean			7312.7	95.6	336.9		541.2		101.1		7616.7	100.0

Source:- Sample survey, 1997/98

Appendix 11

Gross average expense per HH (in Birr) by major headings for 1997/98

Gross average farm expenditure per HH (in Bir)	Sample HHs		Exp./HH on food & others (in Birr)		Exp./HH on seed reserve (in Birr)		Exp./HH on modern farm inputs (in Birr)	
	No.	%	Exp.	%	Exp.	%	Exp.	%
3530	96	22.9	3200	90.7	330	9.3	-	-
3973	60	14.3	3400	85.6	330	8.3	243	6.1
4805	11	2.6	4000	83.2	440	9.2	365	7.6
5418	31	7.4	4400	81.2	330	6.1	688	12.7
5579	53	12.6	4400	78.9	330	5.9	849	15.2
5615	4	1.0	4200	74.8	440	7.8	975	17.4
5736	4	1.0	4200	73.2	440	7.7	1096	19.1
6055	1	0.2	4200	69.4	440	7.3	1415	23.4
6216	17	4.1	4600	74.0	440	7.1	1176	18.9
6732	10	2.4	5600	83.2	440	6.5	692	10.3
6812	10	2.4	5600	82.2	440	4.5	772	11.3
7052	5	1.2	5600	79.4	440	6.2	1012	14.4
7536	15	3.6	5600	74.3	440	5.8	1496	19.9
7826	16	3.7	5600	71.6	608	7.8	1618	20.7
8188	21	5.0	5800	70.8	608	7.4	1780	21.7
8268	9	2.2	5800	70.1	608	7.4	1860	22.5
8429	13	3.1	5800	68.8	608	7.2	2021	24.0
8584	11	2.6	6200	72.2	729	8.5	1655	19.3
8871	2	0.5	6000	67.6	729	8.2	2142	24.2
8869	3	0.7	6000	67.7	608	6.8	2261	25.5
8949	6	1.4	6000	67.1	608	6.8	2341	26.1
9389	4	1.0	6200	66.0	729	7.8	2462	26.2
9833	5	1.2	6400	65.1	850	8.6	2583	26.3
10235	3	0.7	6400	62.5	850	8.3	2985	29.2
10315	5	1.2	6400	62.1	850	8.2	3065	29.7
10711	4	1.0	6400	59.8	850	7.9	3461	32.3
Total	419	100.00						
Mean 5775.9			4466.8	77.3	432.6	7.5	876.5	15.2

Source:- Sample survey, 1997/98

Appendix 12

Comparison between average earning and average expense/HH (in Birr) on modern farm inputs for 1997/98

	Sample HHs.		Av. expense/HH on modern inputs (in Birr)										Av. earning/HH (in Birr)
			Chemical fertilizer		Selected seed		Tractor		Combined		Total		
	No.	%	Exp.	%	Exp.	%	Exp.	%	Exp.	%	Exp.	%	
1	96		-		-		-		-		*		3615-5235
Sub-total	96	22.9	-		-		-		-		-		
-mean			-	-	-	-	-	-	-	-	-	-	4703.4
2	60		243		-		-		-		243		5235-6045
Sub	11		365		-		-		-		365		5235-6045
-total	71	16.9											
-mean			261.9	100.0	-	-	-	-	-	-	261.9	100.0	5707.5
3	31		365		323		-		-		688		6045-6855
	53		365		484		-		-		849		6855-7665
Sub	1		608		807		-		-		1415		7665
-total	85	20.3											
-mean			367.9	46.2	429.1	53.8	-	-	-	-	796.9	100.0	7074.2
4	4		365		484		-		126		975		7665
Sub	4		486		484		-		126		1096		7665
-total	8	1.9											
-mean			425.5	41.1	484	46.7	-	-	126	12.2	1035.5	100.0	7665
5	10		486		-		80		126		692		8475
	10		486		-		160		126		772		8475
	5		486		-		160		366		1012		8475
Sub	11		729		-		320		606		1655		11715
-total	36	8.6											
-mean			560.3	53.2	-	-	186.7	17.7	306	29.1	1052.9	100.0	9465
6	17		486		484		80		126		1176		7665
	15		486		484		160		366		1496		9285
	16		608		484		160		366		1618		9285
	21		608		646		160		366		1780		9285-10095
	9		608		646		240		366		1860		10095-10905
	13		608		807		240		366		2021		10905-11715
	2		729		807		240		366		2142		11715-12525
	3		608		807		240		606		2261		12525
	6		608		807		320		606		2341		12525
	4		729		807		320		606		2462		12525
	5		850		807		320		606		2583		13335
	3		850		969		320		846		2985		13335
	3		850		969		400		846		3065		14145
	1		850		969		400		846		3065		14955
	1		850		969		400		846		3065		17385
Sub	4		850		1131		400		1080		3461		17385-19845
-total	123	29.4											
-mean			615.6	32.3	662.8	34.7	207.5	10.9	422.4	22.1	1908.2	100.0	10506.8
Grand total	419	100.0											
-mean			461.8		564.2		202.8		383.1		1137.0		7616.7

Source:- Sample survey, 1997/98

* Sample HHs who didn't use any modern inputs.

Appendix 13

Distribution of volumes of crops produced (in quintals) and producer sample HHs.

	Crop types	1977/78					1987/88					1997/98				
		Producer sample HHs		Crop produced		Av. amount per HH.	Producer sample HHs		Crop produced		Av. amount per HH	Producer sample HHs		Crop produced		Av. amount per HH.
		No.	%	Amount	%		No.	%	Amount	%		No.	%	Amount	%	
Cereal crops	Wheat	218	95.2	6059.0	55.5	27.8	313	95.7	9011.5	61.2	28.8	399	95.2	12774.5	69.1	32.0
	Barley	193	84.3	2481.5	22.7	12.6	242	74.0	2901.0	19.7	12.0	296	70.6	3108.0	16.8	10.5
	Maize	85	37.1	717.5	6.6	8.4	115	35.2	942.5	6.4	8.2	90	21.5	685.0	3.7	7.6
	'Teff'	55	24.0	472.5	4.3	8.6	60	18.3	480.0	3.3	8.0	62	14.8	371.0	2.0	6.0
	Sorghum	1	0.4	5.5	0.1	5.5	1	0.3	5.5	- -	5.5	3	0.7	16.5	0.1	5.5
	Millet	12	5.2	66.0	0.6	5.5	14	4.3	77.0	0.5	5.5	12	2.9	66.0	0.4	5.5
	All cereals	229	100.0	9802.0	89.8	42.8	327	100.0	13418.0	91.1	41.0	419	100.0	17021.0	92.1	40.6
Pulses	Beans	114	49.8	667.0	6.1	5.9	134	41.0	877.0	6.0	6.5	152	36.3	966.0	5.2	6.4
	Peas	36	15.7	238.0	2.2	6.6	36	11.0	198.0	1.3	5.5	31	7.4	180.5	1.0	5.8
	All pulses	129	56.3	905.0	8.3	7.0	154	47.1	1075.0	7.3	7.0	165	39.4	1146.5	6.2	6.9
Oil seeds		24	10.5	152.0	1.4	6.3	28	8.6	204.0	1.4	7.3	34	8.1	277.0	1.5	8.1
Others		10	4.4	55.0	0.5	5.5	5	1.5	27.5	0.2	5.5	6	1.4	33.0	0.2	5.5
All Crops		229	100.0	10914.0	100.0	47.7	327	100.0	14724.0	100.0	45.0	419	100.0	18477.5	100.0	44.1

Source :- Sample survey, 1997/98

Appendix 14

Questionnaire used For Sample Household Survey

IDENTIFICATION

1. Peasant association _____

2. Climatic zone
   - 2.1. 'Dega' ☐
   - 2.2. 'Weina Dega' ☐
   - 2.3. 'Kola' ☐

3. Age _____

4. Sex — 4.1. Male ☐ 4.2. Female ☐

5. Marital status
   - 5.1. Married ☐
   - 5.2. Not married ☐
   - 5.3. Divorced ☐

6. Family status:- Indicate your family size (Including yourself by filling in the table below)

Year	Family size		
	Male	Female	Total
1977/78 -			
1987/88 -			
1997/98			

7. Literacy status
   - 7.1. Literate ☐
   - 7.2. Illiterate ☐
   - 7.3. If literate, please indicate your literacy level _____

8. Since when did you employ yourself in farming activity?
   - 8.1. Before 1977/78 ☐
   - 8.2. Between 1978/79 and 1987/88 ☐
   - 8.3. Between 1988/89 and 1997/98 ☐

LAND USE

9. Please indicate the total size of your land holding (in hectares) for each of the following years.

   9.1. In 1977/78, _____

   9.2. In 1987/88, _____

   9.3. In 1997/98 _____

10. What major change did you observe in the size of your land holding since 1977/78?

   10.1 Increasing ☐

   10.2. Decreasing ☐

   10.3 No change ☐

11. If your answer for question no.10 is 'decreasing change', what is the reason that you expect for this decrease of your land holding size?

   11.1 Land degradation ☐

   11.2. Some of its part is taken and used for public service ☐

   11.3. Some of its part is taken and redistributed to other farmers ☐

   11.4. If any other reason, please specify _____

   _____

12. Please indicate the sizes of your major land use types for each of the years presented in the following table.

Year	Area of the major land use types (in hectares)				
	Settlement land	Grazing land	Crop land	planted vegetation covered	Other land use
1977/78					
1987/88					
1997/98					

13. Do you have boys of 18 years or above who do not possess their own land holding?

   13.1. Yes, I do ☐ 13.2. No, I don't ☐

14. If your answer to question no. 13 is 'yes' what possible reason do you expect for their not having their own holding?

14.1. Absence of farm land ☐

14.2. Land redistribution is not undertaken ☐

14.3. The boys had other economic occupation ☐

14.4. The boys didn't want to engage themselves in farming activity ☐

14.5. There is shortage of farm land due to population growth ☐

14.6 If any other reason, please specify,

_____.

15. Which one of the following types of your land uses decreased in size more than the others since 1977/78?

15.1. Settlement land ☐

15.2. Grazing land ☐

15.3. Crop land ☐

16. Is your cropland holding fragmented into different smaller plots?

16.1. Yes, it is ☐ 13.2. No, it isn't ☐

17. If your answer to question no.16 is 'yes',

17.1. since when did you face this problem of farm land fragmentation?

(17.1.1.) Since 1977/78 ☐ (17.1.3.) Since 1997/98 ☐

(17.1.2.) Since 1987/88 ☐

17.2. How many fragmentated farm plots do you have at present time

_____

17.3. What is the size of your

(17.3.1) smallest farm plot (in hectare) _____

(17.3.2) largest farm plot (in hectare) _____

17.4. How long it takes you on foot (in average) to reach the farthest located farm plot from your home compound? _____ minutes

18. By filling in the following table, please indicate the sizes of each of your farm plots that you used to cultivated different types of crops in the years presented.

No	1977/78		1987/88		1997/98	
	Name of cropland	Area of the crop farm (hectare)	Name of crop farm	Area of the crop farm (hectare)	Name of the crop farm	Area of the crop farm (hectare)
18.1						
18.2						
18.3						
18.4						
18.5						
18.6						
18.7						
18.8						
18.9						
18.10						

FARM LABOUR

19. Do you have farm animals at present?

19.1. Yes, I do ☐ 19.2. No, I don't ☐

20. If your answer to question no. 19 is 'yes', please indicate the details of the animals by filling in the table below.

Year	Cattle (in number)						
	Oxen	Cows	Heifers	Bulls	Calves	Total	
1977/78							
1987/78							
1997/98							
	Equines (in number)			Sheep & Goats. (in number)			
	Horses	Mules	Donkeys	Total	Sheep	Goats	Total
1977/78							
1987/88							
1997/98							

21. The farm animal that you use most commonly as major source of labour in crop farming is

21.1. Oxen	☐	21.4. Mules	☐
21.2. Horses	☐	21.5. Donkeys	☐
21.3. Cows	☐	21.6. If any other, please Specify _____	

22. Do you cultivate the whole size of your farm land holding by/for yourself?

22.1. Yes, I do	☐	22.2. No, I don't	☐

23. If your answer to question no.22 is 'no',

23.1. then how do you use your farm land holding?

(23.1.1)	Grow grazing grass and sell it	☐
(23.1.2)	Rent to others who cultivate	☐
(23.1.3)	Give to other cultivators by share cropping or any other arrangement	☐
(23.1.4)	If you have any other means, please specify _____	

23.2. Please indicate your major problems that contributed to your unability to cultivate and/or use the all size of your farm land holding in rank order by writing 1,2,3,.... in the space provided.

(23.2.1)	I do not have farm animals	☐
(23.2.2)	I do not have enough family labour	☐
(23.2.3)	I do not have enough farm income to buy modern farm input	☐
(23.2.4)	I do not have the required traditional farm tools	☐
(23.2.5)	If any other, please specify _____	

24. Please indicate the types of farm animal feed you used in each of the years presented by writing 1,2,3,..... in the table below in accordance to their respective importance during the specified year.

Year	Type of animal feed used					
	Natural pasture	Hay	Straw	Stubble	Produced fodder	Any other
1977/78						
1987/88						
1997/98						

25. Have you faced the problem of scarcity in natural grazing to sufficiently feed your farm animals?

25.1. Yes, I have ☐ 25.2. No, I haven't ☐

26. If your answer to question no.25 is 'yes',

26.1. Since when did you face this problem seriously?

(26.1.1.) Before 1977/78 ☐

(26.1.2.) Since 1978/79 ☐

(26.1.3.) Since 1987/88 ☐

26.2. What possible reasons do you expect that resulted in this scarcity of natural grazing?

(26.2.1) the increase in farm animal number ☐

(26.2.2) more land being used for crop cultivation ☐

(26.2.3) the reduced size of grazing land due to the rapid growth of population ☐

(26.2.4) if any other, please specify _____

_____

27. Please indicate your current average amount

27.1. of annual earning (estimated in Birr) from the sell of live animals and/or animal products.

_____

27.2. of annual expense (estimated in Birr) for animal raising and/or care takings. _____

28. Which one of the following is the major type of human labour that you used in your crop production activities?

28.1. Family labour only ☐

28.2. Hired labour only ☐

28.3. Both family and hired labour ☐

28.4. If any other, please specify _____

_____

29. If you employ hired labour, for what activities of crop farming do you hire in most cases?

29.1. Farm land preparations and cultivation ☐

29.2. Crop sowing ☐ 29.4. Harvesting ☐

29.3. Weeding ☐ 29.5. Gathering & threshing ☐

30. Please list the names of the major traditional farm tools that you use in various activities of crop farming.

_____

_____

_____

31. From where do you get these traditional farm tools?

31.1. By buying from local markets ☐

31.2. By renting from other farmers ☐

31.3. By producing at home ☐

31.4. If any other means, please specify _____

_____.

32. As regards to the traditional farm tools you use, please indicate your current average annual

32.1. expense for the purpose of either buying or renting them (estimated in Birr) _____

32.2. earning from their selling and/or renting (estimated in Birr).

_____

33. Do you make use of tractors and/or combine harvesters in your crop production activities?

33.1. Yes, I do ☐ 33.2. No, I don't ☐

34. If your answer to questions no. 33 is 'yes', please answer the questions resented in the following table.

Year	Name of the crop	Area of tractor cultivated farm (in hectare)	Amount paid per hectare of tractor cultivation (in Birr)	Amount of combiner harvested crop (in quintal)	Amount paid per quintal of combiner harvest (in Birr)
1977/78					
	Total				
1987/88					
	Total				
1997/98					
	Total				

35. If you make use of tractors and/or combiners, what are your major reasons that made you to use them?

35.1. Scarcity of human labour ☐

35.2. Scarcity of farm animal labour ☐

35.3. The gradually increasing size of cropland ☐

35.4. the working efficiency of the machinery ☐

35.5. The cheap prices of the services of the machinery ☐

35.6. To modernize the crop production practice ☐

35.7. If any other reason, please specify _____

_____

36. Are the tractors and/or combine harvesters reliably available in your locality at any times?

36.1. Yes, they are ☐ 36.2. No, they aren't ☐

37. In what forms of payments do you get the services provided by these machinery?

37.1. In cash form ☐

37.2. In credit form ☐

37.3. Being paid in crop kind by means of either down or late payments ☐

38. If you use any other modern farm machinery than tractors and/or combine harvesters, please mention them _____

_____

39. According to your evaluation, what do these uses of modern machinery contribute to changes in levels of average production and productivity?

39.1. They increase average production and productivity levels ☐

39.2. They decrease average production and productivity levels ☐

39.3. They contribute nothing to the changes in average production and productivity ☐

40. What major change do you observe upon your need to make use of the modern farm machinery?

40.1. Growing need ☐

40.2. Declining need ☐

40.3. There is no change in my need ☐

41. Please indicate the major problems you encountered in the use of modern farm machinery in descending rank order by writing 1,2,3, ... in the space provided.

41.1. My farm plots being small and fragmented ☐

41.2. The high and increasing service costs of the machinery as compared to my average annual farm income ☐

41.3. The unsuitable and unfavourable relief condition of my farm land holding. ☐

41.4. The scarcity in availability of the machinery in my locality at the times of needs ☐

41.5. If you have any other problem, please specify ☐

_____

_____

42. How many years had passed since you began making use of modern farm machinery?

42.1. About 20 years ☐ 42.2. About 10 years ☐

42.3. Only one year ☐

CROPPING PATTERN AND PRACTICE

43. For how many times do you harvest crops in a year now a days?

43.1. Once in 'Meher' only ☐

43.2. Twice in 'Meher' and 'Belg' ☐

43.3. More than two times ☐

44. If you harvest crops during the 'Belg' when did you begin harvesting in this period?

44.1. Before 1977/78 ☐

44.2. In between 1978/79 and 1986/87 ☐

44.3. In between 1987/88 and 1997/98 ☐

45. Please indicate the amounts (in quintals) and the major types of crops you harvested in each of the respective years presented by filling in the table below.

No.	1977/78		1987/88		1997/98	
	Name of the crop	Amount harvested (in quintal)	Name of the crop	Amount harvested (in quintal)	Name of the crop	Amount harvested Iin quintal)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
Total						

46. Please indicate the farming methods you apply mostly in your crop farming practice by writing 1,2,3,..... in the space provided in order of their descending importance.

46.1 Crop rotation ☐ 46.3. Fallowing ☐

46.2. Inter cropping ☐ 46.4. Dung manuring. ☐

46.5. If any other traditional method you use, please specify

_____

_____

47. To maintain the fertility of your farm (if you do not use fallowing and dung manuring methods at present times) please mention at least three major reasons that limited you.

47.1. _____

47.2. _____

47.3. _____

48. Please indicate the modern farm inputs you currently use in your crop production activity.

48.1. Chemical fertilizers ☐

48.2. Selected seeds ☐

48.3. Weed killer chemicals ☐

48.4. I do not use any kind of modern inputs ☐

49. If you use the modern inputs asked in question no. 48, when did you begin using any one or all of them?

49.1. Before 1977/78 ☐

49.2. In between 1978/79 and 1987/88 ☐

49.3. In between 1988/89 and 1997/98 ☐

50. Are these modern farm inputs available in types, amount, and times of demand in your local markets according to your need?

50.1. Yes, they are ☐ 50.2. No, they aren't ☐

51. Please indicate the respective amounts, unit prices (in Birr), and area (in hectares) of your farm land that you applied the input on of the modern inputs for the years presented in the following table:-

Year		Type of the modern input used			
		Chemical fertilizer (quintals)	Selected seed (quintals)	Weed killer (in litres)	Pesticides (in litres)
1977/78	Total amount used				
	Unit price (in Birr)				
	Farm area the input applied on (in hectare)				
1987/88	Total amount used				
	Unit price (in Birr)				
	Farm area the input applied on (in hectares)				
1997/98	Total amount used				
	Unit price (in Birr)				
	Farm area the input applied on (in hectares)				

52. Please indicate the major problems you faced so far in the supply and use of these modern farm inputs by writing 1,2,3, ... in order of their significance in the space provided.

52.1. Their being expensive and their rising market prices ☐

52.2. Their untimely supply ☐

52.3. Their scarcity in local market s ☐

52.4. My limited financial capacity to purchase ☐

52.5. Absence of credit service ☐

52.6. Absence of loan service ☐

52.7. Problem of physical distance and poor development of rural road transport ☐

52.8. If any other problem, please specify

_____

53. What is the change in your need for the use of these modern farm inputs since you began using? My need is

53.1. Increasing ☐ 53.2. decreasing ☐

53.3. No change in my need ☐

54. What major change (s) did you observe on your average level (s) of production and productivity since you began using these modern farm inputs?

54.1. Increased levels of production and productivity ☐

54.2. Decreased levels of production and productivity ☐

54.3. No change in the levels of production and productivity ☐

55. Please mention the major three important crops that you produce for the purpose of marketing.

55.1 _____

55.2. _____

55.3. _____

56. Is there anyone who is engaged in any kind of off-farm activities from your family members?

56.1. Yes, there is ☐ 56.2. No, there isn't ☐

57. If your answer to question no.56 is 'yes', please mention the type (s) of the off-farm activity (ies) he/she (they) is (are) employed in

57.1. In trading for animal and animal products and/or crops ☐

57.2. In handicraft ☐

57.3. In selling his/her/their physical labour ☐

57.4. If any other please specify _____

_____

57.5. What is the average annual earning obtained from this occupation (estimated in Birr) _____

58. Please present any problem (which is not so far mentioned) that you encountered in your activity of crop farming _____

_____

_____

_____

59. Please suggest some important solutions that you expect to be helpful to improve your low level of labour and land productivity. _____

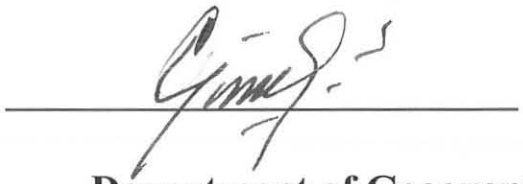
_____

_____

DECLARATION

I, the undersigned declare that this thesis is my work and that all sources of materials used for the thesis have been duly acknowledged.

Name :- **Gezmu Hunde**

Signature :- 

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