

**DETERMINANTS OF FOOD SECURITY IN THE VULNERABLE
AREAS OF ETHIOPIA: THE CASE OF AHFEROM WEREDA IN
REGION TIGRAY**

BY

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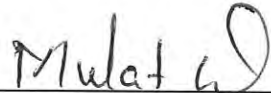
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Acronyms and Abbreviations

CSA	Central Statistics Authority
BoANR	Bureau of Agriculture and Natural Resources of Region Tigray
EHNRI	Ethiopian Health and Nutrition Research Institute
ADLI	Agricultural Development -led Industrialization
SERA	Strengthening Emergency Response Ability
RFSP	Regional Food Security Program
RDB	Rural Development Bureau (of Region Tigray)
FSS	Food Security Strategy of Federal Government.
SNNPs	Southern Nations Nationalities and Peoples
TRFSD	Tigray Region Food Security Desk

ABSTRACT

The drought-prone areas of the country are largely areas of chronic food insecurity. Production-based entitlements supplemented by creation of mechanisms of food access is considered as the major instruments of attaining food security in the rural development and food security strategies of the country. To this effect the diffusion of modern inputs and expansion of agricultural services and soil and water conservation activities are relatively widely employed. Moreover, the enhancement of alternative employment opportunities is emphasized. Nevertheless, there is permanently a low food production capacity and chronic food insecurity in such areas.

This study aims at examining and estimating the determinants of food security perceptions and own food production capacities of sample households from Ahferom Wereda of Region Tigray. The households are asked about the number of months they can cover their annual need from their yearly income/production. They are also requested about the amount of crop they produced in two consecutive years of 2001 and 2002 which is also changed into its calories equivalent and the number of months it can meet the minimum calories requirement of the household is computed. Various socio-economic, technological and environmental factors are identified and their effects on yield, perception of food security status and own food production of the households have been analyzed. For this, cross tabulation of means and percentages are employed. Finally, two linear econometric models are formulated to statistically estimate the outcomes.

The findings of the study indicate that the households have low production capacity and food security status due to various socio-economic and environmental factors. The average month that households perceived that their income/production can sufficiently cover their requirement is 5.23 months. The computed own produced food was able to cover 3.81 and 3.48 months of their minimum calories requirement respectively in 2001 and 2002. Both food security perception and food production are inversely related with family size, dependency ratio, female head of household, past famine experience, rainfall shortages, terrace construction, and getting access to loan. Both are also positively affected by factors such as farm assets, male head of households, involvement in off-farm activities and literacy of head of household. Some factors such as access to extension service, being in highland, employment in non-farm and food for work have inverse relation with food production but direct relation with that of food security perception. Moreover, application of improved seeds could not be helpful in food production while application of fertilizer and either chemical are positive, though insignificantly.

Generally, the technologies and agricultural services could not be helpful in increasing productivity due to largely the agro-ecological problems and illiteracy of the peasant. Especially, terracing, access to loan and extension service particularly to the illiterate are associated with lower yields and food production capacity. The literate is relatively in a better position of getting an advantage from extension service, getting relatively higher yields, using employment opportunities and food security perceptions.

I. INTRODUCTION

1.1 Background

1.1.1 Vulnerability and Food Insecurity in Rural Ethiopia

Food insecurity is a perennial problem in the rural area of Ethiopia due to its vulnerability to expanding natural and man-made disasters for which institutional capacities and technological solutions are not yet developed. The agricultural sector is subsistence agriculture largely detached from helpful research and extension services. It gets little access to appropriate technologies, socio-economic services and alternative employment opportunities (Befekadu and Berhanu, 1999/00; Kifle and Yoseph, 2001; Tadesse, 1999; MEDaC, 1999).

In the absence of appropriate institutional set-ups and accommodating production techniques, the mismanaged natural resources with the age long production techniques are the basis of survival for the alarmingly expanding population. According to Mulat et al (1998) and Welday (1998), landholding size has been diminishing to reach at a level much below its capacity to employ modern inputs and sustain an average family size (cited in Yigremew, 1999). Moreover, those areas which were formerly fertile and productive are being ruined and their productivities are declining (Kebede, 2001; Fassil, 1993). The above authors and others emphatically say that the natural resources are on the verge of absolute destruction and the risk-proneness of the society is being transformed from bad to worse.

Consequently, there is persistent increase in food shortages and food aid dependence of the country. During the last two decades (1981-2001) the survival of an average 10.3% of the total population was annually dependent on food aid (FSS, 2002). Yohannes (2002) refers that 52% of the rural population of the country are food insecure at present and the majority of drought-prone weredas are in food shortage for six months in each year. According to Debebe (2000), the volume of food aid has increased annually at a rate of almost 2.3% from 200,000 MT in 1980s to 1.2 million MT in 1999 (cited in Yohannes, 2002). Official estimates indicated that the food aid requirement was more than 1.8 million MT in the drought year of 2002/03. But in regard to the food shortage of the country, Befekadu and Berhanu (1999/00) say, it has grown six fold within 14 years of the period 1979/80 to 2001 respectively from 0.75 million tons to 5 million tons.

Drought and the prevalence of chronic food insecure areas are the major causes of food shortage and food aid dependence in the country. Drought is frequently recurring and its domain is expanding overtime. However, the food shortages are not attributed to drought years alone, though the disaster in the drought years is immensely severe and high in coverage. Different sources indicate that even in the years of good harvest, there is considerable food shortage and these shortages are expanding overtime (Masfield, 2001; Befekadu and Berhanu, 1991/00; Yohannes, 2002)

Far from finding lasting solutions, these situations of the country confirm that the legacies of the previous disasters are being awfully inherited to generations growing with

an ever-escalating severity even at the dawn of the 21st century. Unless this trend is reversed by appropriate measures, it is not difficult to imagine what the fate of, specifically, the victims and ultimately that of the nation as a whole will be. Temporarily, the lives of the affected population might be rescued by the generous support of national and international communities. However, it is causing the loss of assets and above all the loss of confidence eroding the self-respect and self-reliance of the aid recipients in bringing lasting solution on its capacity.

According to the discussion with experts in Bureau of Agriculture of Region Tigray, some farmers have started to make less farm management practices and investment with the expectations of getting food aid. This testifies the occurrence of what is called Aid Dependency Syndrome. The reason for such behavioral manifestations is primarily the unreliability of the agricultural production which may be reinforced by the food-aid provision mechanisms employed.

At different times, the researcher had the opportunity of observing the living condition of the peasant households in some of the highly populated drought-prone areas of the country. Presently, the shocking observation of their dejected living condition induces one to raise some related fundamental questions within and beyond the scope of this study again and again. This holds true probably for every person coming across to this intolerable but amazingly tolerated reality. In today's time it is because ironic to find a society rich in history but failed to feed itself and has subdued to the agony of poverty and food aid dependence.

What force is making the society succumb to such misery and chaining it from developing corresponding technologies and capacities at least to feed itself? How on earth can a society of the 21st century, where the wonder of human mind is realized in creating miracles, possibly admit its despondency as natural? It is paradox, in other words, to look such disasters like what Ethiopian is experiencing at present where human being is equipped with marvellous knowledge and technologies of immense capacity in solving its problems.

1.1.2 Causes of the Problem

Several natural and man-made calamities, culture, population pressure, lack of appropriate institutions and policies are referred in the literature as causes of this endemic problem. But these factors differ in their contribution to be cited as either fundamental problems or aggravating factors. These are reviewed briefly below.

Natural and Man-Made Calamities and the Peasant

Population has exponentially grown in the second half of the twentieth century (MEDaC, 1999). Population pressure has been cited in the literature as one of the causes of resource degradation, land diminution, low food production capacity (Muluneh, 2001; Ray, 1998; Getahun, 1999; Singh, 1999). Moreover, studies show that the country has experienced different types of calamities (such as drought, pest, flood, epidemic, war etc) which

caused crop loss, human and animal tolls from ancient era to this period (Panckhurest, 1985; Webb and Von Braun, 1994). For instance, Webb and Von Braun (1994) says that the country has unquestionably been denied its human and material resources that could have been cumulated and utilized to improve the standard of living of the society due to the unnumbered wars in its history.

The outcome of continuous disasters, as Swift (1989) says, is vulnerability and poverty that is deepened and expanded in scale by the successive depletion of assets. When the society is plunged to poverty, it has no option other than miserably depleting the available natural and human made resources (in Maxwell and Smith, 1992) Hence, preceding disasters, having cumulative effect to the following periods, have been steadily eroding the capacity of the society to be vulnerable to other subsequent disasters.

However, as far as the fundamental causes of poverty is concerned, the maximum validity of these calamities will be partial as the problem are not special to the country. It is in the absence of internally built capacities helpful to prevent or endure the challenges that the effects of these disasters are enormous. So, it is even absurd to allege basically natural or other external forces for the long-term underdevelopment and impoverishment of the country in general and the farming society in particular.

Similarly, it is not strong to argue on the bases of the peasants' inefficiency and laziness as a root cause and blame it for its failure to solve its problems. No strong support is available for this assertion nowadays after writers such as Schultz (1964) argued for its

efficiency and the findings of others, which rather give ample contrarily evidences or justifications for its inefficiency. In fact, due to poverty, uncertainty and lack of options; the farming society may employ mechanisms that guarantee the sustainability of the household at the expense of efficiency (in Yared, 1999; Maxwell and Smith, 1992). The experience of peasants in our country that are destined to perform drudgery farming activities bar to its scanty return does not also teach us their indolence and heedlessness to improve their way of life. This does not deny, however, the impacts of its culture. Hence, the solution for the “riddle” food insecurity, whether created or reinforced by the calamities and cultural practices, should be solved by the policies and the institutional capacities. Here lays the capacity to really decipher the puzzle of the peasants’ backwardness and food insecurity.

Policies and Institutions

According to (Narayan, 2000, Bucknall et al, 2000), vulnerability to food crisis of households emanates from its own low capacity and the low capacity of the government to forestall the crisis. In this case Webb and Braun (1994) say that if there is failure of the government in either entitlement protection (provision of emergency relief) or in entitlement promotion (development activities), this leads to vulnerability to an erosion of food security and descent the slippery slide towards famine. Therefore, the effectiveness of development strategies and policies is a basic issue. This should be raised as a source of solutions or failures of the country to have evolving institutions and develop technical capacities that are capable of increasing production and preventing resource degradation.

In this case, the consecutive governments in the country have played central role in perpetuating the deplorable living conditions of the poor. This is by having wrong conceptions of development, following repressive (exploitative) policies and failing to take appropriate development and security measures (Tadesse, 1999; Yigremew, 1999; Befekadu and Berhanu, 1999/00; Abrar and Semira, 1999).

During the imperial regime for instance, though there were varying landholding arrangements at different areas of the country, all of them are responsible for relentlessly impoverishing the peasant and the resources degradations. The landlord-tenant relationship, especially in Southern part of the country, is blamed for denying the right of the peasant of land access and its produce (Gedion, 2001; Getachew, 1995). Similarly, in the North the increased demand for land of the nobility (the state and church) precipitated the scarcity of the land created by population pressure (Pausewang 1983). The failure of the package programs is largely attributed also to the tenure system and the policies of the government. Therefore, the institutions of the government and the church let alone to give appropriate solutions to the demand of the time were bound to add fuel to the already blazing fire of land scarcity by the expanding population.

After making radical changes in the land tenure system, the military government followed similar harsh measures on the peasant. It gave priorities to the small fractions and inefficient socialized sectors (state farms and producers' cooperatives). The small

peasant was discriminated and exploited by the government in its credit, input supply, marketing and price policies (Getachew, 1995; MEDaC, 1999).

The present government was applauded by many as pro-poor in giving priority to the agricultural sector in its policies and strategies (Masefield, Abi, 2001). However, many writers seriously criticize the agricultural and food security policies and strategies. Among these, the top-down approach followed in extension and conservation programs (Origin, 1999; Senait, 2001; Dejene, 2001; Tarekegn, 2001; Bahru and Pausewang, 2002) is the major shortcoming from which the other problems emanate. In addition to top-down approach the other limitations are lack of land security, lack of clarity about the problems and solutions of chronic food insecure areas, lack of proper technology transfer adapted to specific agro-ecology (Yigremew, 1999; Dejenca, 2001; Beyene, 2001; Tesfaye, 1999; Senait, 2001).

In general, the peasant has been denied its different rights such as secured access to land and the right to decide on factors that determine its livelihood. The denial of these rights facilitated the resources degradation and disavowed sustainable land use (Gedion, 2001; Getachew, 1995). Besides, it lead to internal instabilities. The country has missed huge resources and development opportunities due to internal instabilities and lack of tranquillity (Gedion, 2001; Webb and Braun, 1994). These are due to the weaknesses of the citizens and primarily the bodies at power to create a stable government that is responsive to the problems of the society.

Consequently, the scanty resources have either been misused in running ineffective programs or drained in waging wars due to the endless internal instabilities. Therefore, fundamentally these conditions of the country are breeding vulnerability which are the grounds for the endemic food insecurity and poverty. This is either in denying the peasant helpful opportunities (such as educational, technologies, etc) or in prescribing harmful ‘medicines’ for the properly undiagnosed ailment.

Therefore, chronic food insecure areas are expanding due to backlogs of policy failures and lack of development measures that avert vulnerabilities and redress the effects of previous calamities. These have succeeded in thwarting the competence of the amazing human mind from being capable of creating the techniques that unleash the society from all sorts of afflictions. These are responsible for bestowing the poor a prey to the reinforced natural and man made calamities such as the effects of drought and population pressure. Finally, this situation is tending to culminate presently in absolute pessimism of inability to unravel the “paradox” of food insecurity and poverty. That is why at the moment, the society has accustomed to the humiliation of imploring others for food.

1.1.3 Food Security Measures

Generally, different writers have said that the measure to uproot the firmly established poverty is enabling the poor to be self-reliant and capable of solving its own problems. In this regard, the peasant households should be entitled to socio-economic opportunities, production augmenting capacities, and protective securities where its active involvement

is required as to the selection of priorities and their management (Sen, 2001). Among these, the supply based food security measure (increasing the food production capacity of the agricultural sector) constitutes one of the major instruments of food security in the farm households. This can be evaluated by the policy priority in creating the availability of the technologies and agricultural services, and their effectiveness in increasing food production capacity of the farm households.

The present government has taken commendable initiatives and measures in giving priority to the small peasant agriculture in its policies and strategies but with its limitations (Befekadu and Berhanu, 2000; Senait, 2001). The access to modern inputs and agricultural services has comparatively been expanded (Senait, 2001). However, in addition to the problems with the non-participatory approaches followed (Origin, 1999; Senait, 2001), the consistent existence of food deficit areas (FSS, 2002; Befekadu and Berhanu, 1999/00) questions the effectiveness of the introduced programs. The country could not attain a thriving society that is freed from the torments of food insecurity. The effect of drought is expanding to unparalleled level where a growing size of population has severely been plunged to poverty and vulnerability.

Induced by these state of conditions in the country, this study is an attempt of examining the factors generally affecting the food security level in Ahferom wereda of Region Tigray. It examines the effectiveness of the extension program under the context of the socio-economic and environmental factors.

1.1.4 Vulnerability in Tigray

The region is one of the most vulnerable areas of the country where significant size of the population is suffering from food insecurity. The extent of vulnerability and food insecurity of the population of the region can roughly be observed from the unbearable burdens of natural and human-made calamities shouldered by the region, and the subsequent socio-economic and environmental situations of the region.

Natural resources. In terms of natural resources degradation, Tigray Region is one of the severely affected regions in the country. The process of resources degradation (soil erosion, deforestation) that has been unabated for centuries is highly aggravated recently by factors such as growing human and livestock population, traditional agricultural system, erodible physical feature and erosive characteristics of rainfall (BoANR, 1995 EC). The annual soil loss of the region is estimated by studies to be 17-42 metric tones per hectare of land 80% of which occurs on the cultivated land (cited in BoANR, unpublished). There is high decline in ground water, decline and/or drying up of rivers and streams that were flowing the whole year. Hence, according to this source, agricultural production sharply declines both in crop and animal husbandry. In general, the resource degradations resulting from its mismanagement has reached at a level where the arable land could no longer sustain the ever-increasing population (Mitiku and Kindeya, 2000).

Famine: The region is haunted by the spectre of famine triggered by various calamities such as war, drought, pest attack, and animal diseases. These calamities, happening alternatively or simultaneously, are dragging the society deep into the abyss of poverty and vulnerability. Drought, for instance, has become a recurring calamity that relentlessly deprived the means of living to the entirely rain dependant farmers in the region. Moreover, the society is a victim of several wars instigated by external aggressions and internal conflicts in the country's history.

Food insecurity: the unrestrained calamities coupled with burgeoning population that employs traditional farming technique have produced a region that epitomizes chronic food insecurity in the country. The severity of food insecurity of the region can clearly be indicated by the average landholding size (.54ha), low yield (8.86qt/ha); significant average family size (4.5- 5.0 persons), and the consequent food insecurity of 82- 90% of the population (EEA, 2002; Middle Brook and Mengesha, 2001; Senait, 1999)

With the purpose of tackling the widely existing vulnerability in the four regions (Tigray, Amhara, Oromia, and SNNPs), the federal government has formulated food security programs to be implemented in 156 identified as food insecure, and vulnerable weredas of the four regions. In line to this program, the region has selected 16 most vulnerable weredas in the region. One of these weredas is Ahferom wereda the subject with which this study is concerned.

1.2 The Study Area

1.2.1 Location and Physical Characteristics

Location and size of the wereda: Ahferom wereda is found in the Central Zone of Region Tigray. Ahferom wereda is located in the Northeast of the Central Zone with in a distance of 55km from Axum, the capital of the Zone. An all weather road that passes from Mekelle through Adigrat to Axum crosses the capital town of the wereda. The wereda ranges from $14^{\circ} 06'30''$ to $14^{\circ} 38'30''$ North in latitude and longitudinally from $38^{\circ}56'30''$ to $39^{\circ}18'0''$ East. It is bordering with Eritrea in the North, Gantafeshum and Gulomekeda weredas in the East, Woreileke wereda in the South, Adawa and Merebleke weredas in the West (TRFSD, 2002).

Climate and resources: There are two major rainy seasons in a year in the central zone in general. One rainy season starts in early March extending to early June while the second major rainy season extends from mid June to September (RDB, 2002). However, as the wereda is one of the drought-prone areas, the mean annual rainfall of the wereda for a series of years was found to be 579mm (TRFSD, 2002). According to RDB assessment, for instance, in the drought year of 2002/03, there was no rain at all in the first rainy season (March to June) and in the second season it started late in July 26 to withdraw early in September 6 in the zone as a whole.

According to the above source, the wereda has a total area of 133,500 hectares that accounts 25.40% arable land, 12.05 % grazing land, 32.41% forest and woodland, 30.15% residence and other non-productive land. The soil in the wereda is generally characterized as stony loams and sandy loams. The productivity of the soil is low due to low organic and nitrogen content (TRFSD, 2002).

1.2.2 Demographic characteristics

Ahferom Wereda is one of the densely populated areas of the country. The total population of the wereda is estimated to be 131,168 in 1994 and 152,439 in 1999. Moreover, this is projected to reach 168,546 in 2003 (TRFSD, 2002; RDB, 2002). According to TRFSD (2002), the rural population accounts 93% of the total population of the Wereda where the arable land is 33,979 hectares. Taking the projected population size in 2003 and the arable land, the population density is 4.96 persons/hectare of arable land.

Age distribution and household headship: The wereda is not different from the other parts of the country in having a high proportion of young age population and significant economic dependency ratio. According to CSA census 1994, the economically active age (15-64) accounts 51.1 % of the total population while the balance 49.9% make up the young (44.5%) with an age of < 15 and old age (4.45%) greater than 64 of age group. Hence, the dependency ratio in the wereda is 96% (TRFSD, 2002).

In respect of the number and sex of the head of the households in the Wereda, this source indicates that from a total number of 32,030 households (69%) are male and (31%) are female-headed households.

1.2.3 Extension and Agricultural Production

Extension: In the wereda, the number of households involved in the extension services, extension area coverage, and the number of extension agents have increased in the period 1996 to 1998 but declined in 1999 (TRFSD, 2002) due to perhaps the Ethio-Eritrean war. According to the above source, the percentages of households involved in the extension program were 22.3% in 1996, 49.0% in 1997, 58.4% in 1998, and 47.3% in 1999.

Crop production and its problems: The two major agricultural activities are crop production and animal husbandry. The productivity in the crop production is dismally low as indicated in the table below. The major crops grown in the Wereda respectively according to their importance are 'teff', 'hanfets' (a mix of wheat and barley), wheat, sorghum, and millet (TRFSD, 2002). The total cultivated area and production in the period is indicated below.

Table 1.1 Cultivated land, production and yield of crops in the worda (1997-2000)

Activities	Year	1997	1998	1999	2000	Total
Cultivated Area (ha) ^a		23873	24424.3	26117.3	31589	106003.6
Production (qt) ^a		73879	150925	135104	142674.7	502582.7
Yield(qt/ha) ^b		3.09	6.18	5.17	4.5	4.74

Source: ^a1997-99 formulated from TRFSD (2002), 2000 from BoANR (2001)

- ^b Own computations

The low productivity (less than 5qt/ha) is clearly the major reason for food shortage in the wereda. This low yield arises due to various reasons such as decline in land fertility, rainfall shortage, traditional techniques of production, flood, weed, pest, snow, etc. For instance, the pre-harvest loss due to rainfall shortages, flood, weed, pest attack, and snow in 2000 is significant as indicated in the table below.

Table 1.2: Estimated pre-harvest crop loss and causes in the year 2000

Causes	Rainfall shortages	Flood	Snow	Pest	Weeds
Crop loss (qt.)	60906.3	1803	7662	2684.5	3789.45

Source: Formulated from BoANR of region Tigray

Hence, it is not difficult to estimate the impact of these natural calamities on the food production of the farm households.

1.3 Statement of the Problem

It is not easy to get a complete explanation and rationale for the present state of unbearable burden of poverty and food insecurity of Ethiopia in the face of food security achievements of the rest of the World including some developing countries. Though the developed countries have endured problems that can parallel to the present problem of developing countries, a number of years have been counted after they have attained the institutional and technical capacities with which absolute poverty is unthinkable. There are also a number of developing countries which are able to develop their food access and production capacities shortly within the last 30-40 years after having harsh experiences.

On the other hand, Ethiopia has gone through different socio-political systems and followed various development policies and strategies. The development endeavors began five decades back during the imperial regime by preparing development plans. But, with no avail, this gave its place to the radical political changes in 1974. It has been also three complete decades since the country has embarked socio-economic and political changes. There is no doubt that most of these social movements for changes were primarily undertaken with the expectation of bringing rapid improvement in the living condition of the peasant. But to the contrary of all these expectations and the momentous development achievement of the other part of the world, substantial size of the Ethiopian peasant faces annual food shortage and hence is still compelled to drag much heavier burdens of poverty and vulnerability.

In general, to attain food security it requires increasing food production capacity, creation of non-farm employment areas, and devising sustainable resources use and development mechanisms (Mulat, 2001; Azene, 2001). Therefore, production base entitlement is one of the major tools employed particularly in the peasant agriculture. However, besides to the absence of conducive policy environment, the limited accessibility of agricultural technologies and services are cited as cause of low productivity in the small peasant agriculture on which the imperial and military governments are criticized.

It has been more than a decade after the present government has introduced strategies and programs in favour of the small peasant agriculture. After the policy changes that gave priorities to the rural sector in resources allocation, evidences indicate that there is an

improvement in the provision of socio-economic services in these areas at present. Among these relative improvements include supply of improved inputs, credit and extension services, conducting resource conservation programs widely, and socio-economic infrastructural development. Theoretically all these opportunities should contribute to the enhancement of the quality of life of the peasant. Among other improvements, their benefits should be ascertained in the form of increased productivity and income sources.

Despite to this fact, generally as indicated on the background, there is still annual food shortage in the country. Specifically, the vulnerable areas are able to produce sufficient food for not more than six months in average every year (Yohannes, 2002). Problems such as lack of access to modern inputs appropriate to the agro-ecology, lack of proper application of technologies (due to illiteracy of the peasant and lack of proper extension service), lack of adequate farm assets (such as land and oxen), etc, are expected to be serious problems encountered. Hence, it is imperative to make an assessment of the relative effectiveness of the technologies and services under the different socio-economic and agro-ecological circumstances.

The study area, Ahferom Wereda, is found in Tigray National Regional State identified by the Regional Government as one of the 16 vulnerable Weredas facing significant food shortages from year to year. This study examines the extent of food insecurity and its causes. Particularly, it focuses in examining the contribution of the interventions and

other socio-economic factors on food production and food security perception of the households.

1.4 Research Questions

The specific questions of the study are: i. What are the extent of entitlements in the form of farm assets, access to agricultural service, technologies, and employment opportunities of the farm households? ii. What is the food production capacity and food security status of the peasant households? iii. How do factors such as educational status, demographic factors, farm assets, institutional services, technologies, and agro-ecologies influence food production and food security status of the households? iv. Is the role of the extension program (extension service, modern inputs, terracing) affected by the educational status of the head and agro-ecological factors? v. Is there a difference in productivity and use of opportunities between the literate and illiterate heads of households?

1.5 Objectives

The general objective of the study is examining the socio-economic, demographic, and environmental determinants of food production capacity and food security status of the households.

Specific Objectives:

- i. To consider the households' possession of farm assets (such as oxen, livestock, land), access to and use of improved inputs, credit, and extension services.
- ii. To consider the level of involvement in alternative employment opportunities
- iii. To examine the effects of educational status of the head and agro-ecological factors on annual crop production and yield of technologies
- iv. To examine the food security status perception of the households, compute their food production and analyze the socio-economic, demographic, and agro-ecological determinants

1.6 Significance of the Study

This study would contribute to the understanding of the socio-economic and demographic constraints in food security and development in the densely populated areas of the country. The literature review and empirical analysis are expected to have both academic and practical values. In academic perspective, the empirical investigation will add to the available limited studies made in the country in regard to the contribution of the extension program and the socio-economic and demographic constraints in food security. It is also expected to give an insight on the contributions of the programs that will be helpful in designing and implementing interventions. Moreover, this research may be a base that gives raise to initiatives of conducting in-depth further studies on specific aspects influencing food security and development.

1.7 Limitations of the Study

This study is based on a larger sample size from a wereda that covers broader aspects of socio-economic, demographic and agro-ecological circumstances of the households. These include an inventory of their crop production, livestock, use of input, perception of food security and encountered problems. This gives an insight about the general constraints in the area and other similar areas.

However, it has also certain limitations. Firstly, this study takes a sample of only one Wereda of a region. Secondly, the analysis is made based on the households' own estimation of crop production and perception of food security status. The third limitation is in formulating the linear regression model. This model is formulated on the assumption of subsistence farm households that entirely depend and consume own produced food. In this case, the study does not consider crop and livestock transactions or other sources of food quantitatively in computing the annual food access of the households. The fourth limitation is the qualitative nature of the data regarding use of inputs, access to credit, involvement in alternative employment opportunities, and farm management practices. Nevertheless, the study is hoped not to be short of giving an insight of the key determinants of the livelihood of such areas. Moreover, the household's perceptions of food security status and food production are expected to complement each other and address the limitations.

1.8 Organization of the Study

The study is organized into seven parts. **Part one** is the introductory part dealing with the background, the location and socio-economic characteristics of the study area, statement of the problem, objective and significant of the study. **Part two** focuses on the theoretical framework and literature review. In this part, definition of concepts, measurement of food security, literature about the determinants of food security and vulnerability is reviewed, and model employed is indicated. **Part three** is in regard to the data set and the methodology employed in this study. **Part four** is the descriptive analysis of the households' demographic characteristics, resource endowments, access to agricultural services, access to modern inputs, sources of vulnerability, the crop production and yields of inputs. **Part five** and **six** focus on the examination and analysis of the socio-economic, technological, and environmental determinants of food security perception and own food production of the households. Lastly, **part seven** summarizes the major points and illustrates the consequent recommendations of the study.

II. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Definition of the Concepts

Evolution of the concept of food security: Food security has been perceived and defined differently at different times by the academics and practitioners in an attempt of having a framework and operational principles in solving the problem of food. In the 1970s it was considered to mean the availability of adequate food supply at national or global level. Then it shifted its area of concern to food access in the early 1980s and stable food access at household and individual level in the late 1980s (Frankenberger, 1992; Maxwell & Smith, 1992).

Sen (1981) is credited for bringing a shift in paradigm directing the emphasis of researchers and practitioners to vulnerability and entitlement problems of households (or individuals) even under the context of plenty of food availability at macro level (Frankenberger, 1992). According to Amartya Sen (1981), the emphasis should be on access/entitlement of an individual (household) to income earning employments and resource endowment that can be transformed into food through production and trade (in S. Maxwell & M. Smith, 1992).

Recently, the concept has been broadened in its scope to food security by incorporating stability (future sustainability), in addition to its availability at macro level and present access. Stability is the absence of risk of food shortage even in times of sudden shocks.

Stability gives rise to the importance of sustainable use and maintenance of resources for its realization (Yohannes, 2001; Tekle and Yoseph, 1999; Webb and Von Braun, 1994).

Present definition of food security: Therefore, food security in this period, as discussed and used by different authors and organizations (such as FAO, WB, WFP, etc.), is summed by S. Maxwell & M. Smith (1992) as: “**secure access to enough food all the times.**” In a more elaborated way, the concept is defined by the above institutions as the “**access by all people at all times to the food required for them to lead a healthy and productive life**” (Webb and Von Braun, 1994; Kifle and Yoseph, 1999; Yohannes, 2001; S. Maxwell & M. Smith, 1992).

Hence, the core notions of the concept in the above definition as briefly stated by Maxwell and Smith (1992) are sufficient food calories required for an active and healthy life; access to food, defined by entitlement to produce, purchase or exchange food or receive it as gift; security, explained in terms of the balance between vulnerability, risk and insurance; and d) time, where food insecurity can be chronic, transitory or cyclical.

Food Insecurity and vulnerability: The antithesis of food security is food insecurity. Vulnerability and food insecurity are used interchangeably in the literature to mean the risk of access to enough food of the household. Chamber has defined vulnerability as ‘defencelessness, insecurity, exposure to risk, shock and stress, and difficulty in coping with them’ (in Frankenberger, 1992). The welfare vulnerability or risk of access to food of a household may arise from fluctuations of factors such as food supply, prices,

employment (and income), and conflict caused by nature, state, market, the community, etc, (cited in Webb and Von Braun, 1994; Maxwell & Smith, 1992).

2.2 Sources of Vulnerability and Entitlement Promoting Factors

The determinants of food security are thus related to factors that influence the present food access (employment and income, production) and its future sustainability. This makes the study of food security multifaceted requiring consideration of all aspects and processes of livelihood, socio-political and the agro-ecological factors (cited in Frankenberger, 1992; Webb and Braun, 1994). Therefore, food security is determined by the types of available resource endowments, the employed policies, production possibilities and the associated threats (Webb and Braun, 1994; Sen, 2001).

Sources of Vulnerability

Vulnerability (or risk of access to food) of a household may arise from fluctuations in food production, prices, employment and income, and resource degradations (cited in Webb and Von Braun, 1994; Maxwell & Smith, 1992). Hence, vulnerability is the deprivation of these physical and human resources in quality and quantity; the exposure to natural and man made calamities; and absence of technical and institutional capacity to tackle them.

Lack of education and physical resources: lack of education, shortage of physical resources and their susceptibility to natural hazards are the immediate sources of vulnerability. Among these, the most important resources that the poor is deprived are skill and knowledge (Burkey, 1996). According to Burkey, lack of knowledge and information not only hinder the poor from effectively utilizing the few resources that they do control but also prevents them from competing successfully for their fair share of resources. Moreover, the farming households are encountering the problems of farm assets, resources degradations and diminishing land size, erratic rainfall, susceptibility to pest and other hazards (Fassil, 1993; Azene, 2001).

Resources degradations (such as soil erosion) and depletion of assets are the major sources of vulnerability of the farm households. The causes of degradations of the natural resources in Ethiopia and depletions of assets in general are classified to **human, environmental, and structural factors**. The human factor includes its backward farming practices, animal and human population pressure, and use of nutrients for energy. The steep slope terrain, erosive rainfall and erodible soil types of the country are the environmental factors. Lack of appropriate soil and water conservation practices, lack of tenure security, wars, poverty, etc are the structural factors (Belay, Gedion, 2001; Muluneh, 2001; Azene, 2001; Senait, 1999). As these all are related to population pressure, policy failures, institutional and technological development problems, poverty, the related literature is reviewed in the following topics.

Lack of appropriate technologies: Failures to adapt the agricultural technologies to suit the specific agro-ecological and socio-economic conditions are cited in the literature as principal causes of their ineffectiveness. With the assumption of universal applicability, imposed technologies have resulted serious failures (in Biggs and Farrington, 1990).

Failure in public programs: Public services in developing countries are said to be usually non-participatory, inefficient and short of effectively and fairly addressing the problems of the poor. Discrimination, humiliation, harassment of the poor by the powerful public officials who abuse the power vested upon them are common practices (Narayan, 2000; Thomas et al 2000; World Development Report, 2000-2001). Shortages of skilled human resource and lack of participatory approach in the public sector are cited as a cause of failures of programs (Lai, Sen, 2001). Moreover, the poor especially the illiterate lacks awareness of its rights and the power of protecting itself from the abuse of the elite (Burkey, 1996).

Population pressure: There are several views on the effect of population on food production food at macro and micro level. The views range from those which consider population growth in developing countries as a liability to those attributing it as an essential asset for development. The two extreme macro views are the Neo-Malthusianism and the Boserupian views. The impact of burgeoning population on diminished carrying capacity of land and depletion of the natural resources is the emphasis of the Neo-Malthusians (cited in Todaro, 2000; Ray, 1998; Dejene, 2001). Nevertheless, the Malthusian view of population growth as a cause of food shortage and

resources degradation is either completely rejected by some researchers or reduced by others to work under certain circumstances.

The experience of countries in the history of mankind and some of the recent empirical studies made are against the Malthusian arguments. The literature indicates that the agricultural system and its productivity have been changing in order to meet the food need of the increasing population density of an area. This is confirmed by the consistent shift of the agricultural systems from hunting & gathering, shifting cultivation, village cultivation, & finally to high agricultural productivity growth of the advanced countries (cited in Stevens & Jabara, 1988).

The antithesis to the Malthusian view, which turned it upside down, is the Boserupian thesis that argues the prevalence of matching growth of food production to meet the food need of the increasing population (in Ray, 1998; Dejene, 2001; Todaro, 2000). Easter Boserup argues that growth in population stimulates food production capacity by having talented individuals and impelling corresponding technological advancements. There are also other researchers that agree to this theory. For example, in a district of Kenya it was found that population growth was accompanied with resource conservation, growth in agricultural production, expansion of economic activities and improvement in standard of living of the society (Tiffin and Marry, 1994)

Despite to the above macro arguments, the effects of population growth at micro (family) level argued by the neo-classical theory and the empirical findings are directly related to

a study concerned with food access of households. In this regard, the findings illuminate that there is a tendency of poor household of having large family size with high dependency ratio, mainly children, as compared to their counterparts (in Singh, 1999; Getahun, 1999; Ray, 1998; Todaro, 2000; Frankenberger, 1992). The writers indicate that the poor parents prefer to have more children as an investment for labour supply and source of security in their old ages.

The high dependency ratio/family size, which not only limits the saving capacity of the household but also dilutes the available food. The low nutrition and saving capacity produces weak labour and low investment reproducing poverty to the future (Ray, 1998; Getahun, 1999; Getachew, 2001) at macro and micro level. Labour becomes susceptible to sickness and disability albeit the main asset of the poor people is their labour (Frankenberger, 1992). Moreover, the macro argument of the Neo-Malthusian theory implies a household produces less food in lesser quality and quantity of land but to an increasing family size.

Famine and poverty: Poverty and frequent exposure to famine are considered in the literature as the root causes of resources degradations and depletion of household assets rather than population pressure. Hence, as the Malthusian theory is disproved by technological advancements, the realizations of both extreme (Neo-Malthusian and Boserupian) views are contingent on and rooted in the structural factors. For instance Boserup is criticized for her failure to distinguish between the effect of population growth and increased per capita income on demand as to which impels technical progress (Ray,

1998). This is because, Ray says, income is important determinant of demand the rise of which can induce technological progress than mere size of population.

Similarly, in contradiction to the Neo-Malthusian view, there are views that ascribe the association of population growth and resources degradation to other socio-economic and institutional conditions. Some of the reasons that prevent the poor from preserving and developing its environment are food insecurity and poverty, the restrictions of access to resources, lack of security right to resources, lack of employment and income opportunities, limited access to credit, etc (in Dessalegn, 2001; Dejene, 2001; Senait, 2001). Maxwell & Smith (1992) cite from their literature review that if peasants are not entitled to adequate food and assets that can be translated to food, and if it is repeatedly threatened by food shortages, the peasant takes depletion of not only its environment but also its productive assets as a last resort of survival.

Entitlement Promoting Factors

Resource Endowments: Given the technological level, the production capacity of the farm household and its access to food is determined by the quality and quantity of the human and natural resource endowments. These are specifically the quantity, skill and knowledge of the labour force; the land size and its fertility; other farm assets such as oxen and farm tools; the quantity and quality of rainfall and; the prevalence or other wise of susceptibility to pest and other hazards (Azene, 2001; Fassil, 1993; Burkey, 1995).

Especially, the multidimensional role of education in enhancing the overall capacity of the poor is emphasized in the literature. Development of human capital in general and education in particular is the major tool of increasing the asset of the poor, enhancing political rights, alleviating poverty, and reducing inequality. This is by enabling the poor to access information, understand and making use of the available opportunities in solving its problems, articulate its interest and having active participation in decisions (WDR, 2000; Maropa et al, 2000; Claeson et al, 2000; Sen, 2001; Burkey, 1995).

Agricultural technologies and institutions: Improved technologies and resources management techniques are the instruments that enabled human kind to develop the resources and meet the increasing food need of the densely populated areas. For this purpose, according to Ruttan, societies have been required to employ technologies that range from the conservation activities to the modern high yielding inputs helpful for maintaining soil fertility and intensifying the land (in Eicher and Staatz, 1990).

Despite to pertinent institutional and resources limitations in their access and adaptations, the technologies have ascertained their viability in increasing productivity in the package programs of the imperial regime and the extension program of the present government (Mulat, 2001; Tesfaye, 1999). According to Tesfaye, an increase in productivity of two to four folds has been attained in the extension program. Berhanu (2000) also says stone terrace experimented in an area of Region Tigray has significantly differed in yield and straw supply with relative stability where the internal rate of return is 50 percent for 30 years.

Alternative employment opportunities: The entitlement of the poor to diversified income earning alternative employment opportunities such as non-farm and food for work are used to compliment or substitute the agricultural activities. These are recommended especially in the densely populated areas to have an advantage at both macro and household level. Their access can be used by the household as a hedge against food shortages preventing depletion of its assets; transform labour from agriculture to other sectors and preventing further diminution of the land and; bringing overall rural development (in Eicher and Staatz, 1999; Mulat, 1996; Maxwell and Smith, 1992).

Favourable policy environment: The causes of food insecurity and resources degradation are directly or indirectly attributed, in the literatures above, to the failures of the governments in playing their role in their policies and practices. The literature emphasize the role of the government to be widening opportunities to the poor and creating conducive policy environment that involves the stakeholders. According to World Bank (1984) and FAO (1997), for instance, the response of the government to food security is indicated by creating mechanisms of food production and its availability, its access, and disaster prevention and preparedness capabilities (in Yohannes, 2002).

A number of writers have also insisted on the need of land and tree tenure security and land use policies as an essential condition for sustainable resources use and development along with food security in Ethiopia (Azene, 2001; Dejene, 2001; Dessalegn, 2001). According to the writers, the prevalence of these securities with flexible and efficient

land administration that provides due attention to the interest of the peasants is the only way out of the existing food insecurity and resources degradations.

These are strengthened by other authors saying the access to food and its sustainability depends on the access to socio-economic opportunities, safety net mechanisms, and empowerment of the deprived poor in making decisions about its livelihood (Sen, 2001; Bucknall et al, 2000; Edgertan et al, 2000; Burkey, 1993; Maxwell and Smith, 1992). According to Sen, all these opportunities are the means as well as the end of the overall development objective, including curtailing population pressure.

The above authors emphasized on the vital role of promoting participatory approach. Participation of stakeholders improves the effectiveness, efficiency, equity, and sustainability of food security programs. Accordingly, the active involvement of the stakeholders is therefore an essential means of mobilizing resources, enhancing their capacities, and self-reliance as well as a value that should be pursued for its own sake.

2.3 Food Security Measurements

After reviewing different literature, Frankenberger (1992) has summarized the food security indicators into '**Process Indicators**' and '**Outcome Indicators**'. The process indicators show the socio-economic and environmental processes that determine the aggregate food availability and its entitlement. The outcome indicators, on the other

hand, include consumption indicators such as food budget, food security perceptions of households, storage estimates, and subsistence potential ratio at the household level.

In this study, **food security status perception** of the households ('extent of self-provisioning') and the **subsistence potential ratio** are employed. Perception of the household is a direct consumption indicator used to estimate its level of food security by asking its opinion about their status of food security. Chattopadhyay (1991) says an example of this method is the 'extent of self-provisioning' in terms of months covered from its own production and receipt of labour. The subsistence potential ratio compares the amount of food (in calorie) which the household can produce in a year with the calorie requirement of the entire households for the year. According to Frankenberger (1992), this is useful in communities that consume mainly their own production. The participation of the households in other food/income earning activities such as non-farm, off-farm, and food for work are usually local specific entitlement indicators (in Maxwell and Smith, 1992; Frankenberger, 1992).

2.4 Model Employed for Food Security

Figure 2-1 shows the Conceptual Framework of the processes that lead either to food security or to the deprivation and vulnerability of households. These past and present experience of environmental and man-made hazards, and the policies of the government in establishing necessary socio-economic institutions to address the problems determine

what capacity does each household have and what decisions can it make in producing food and earning income.

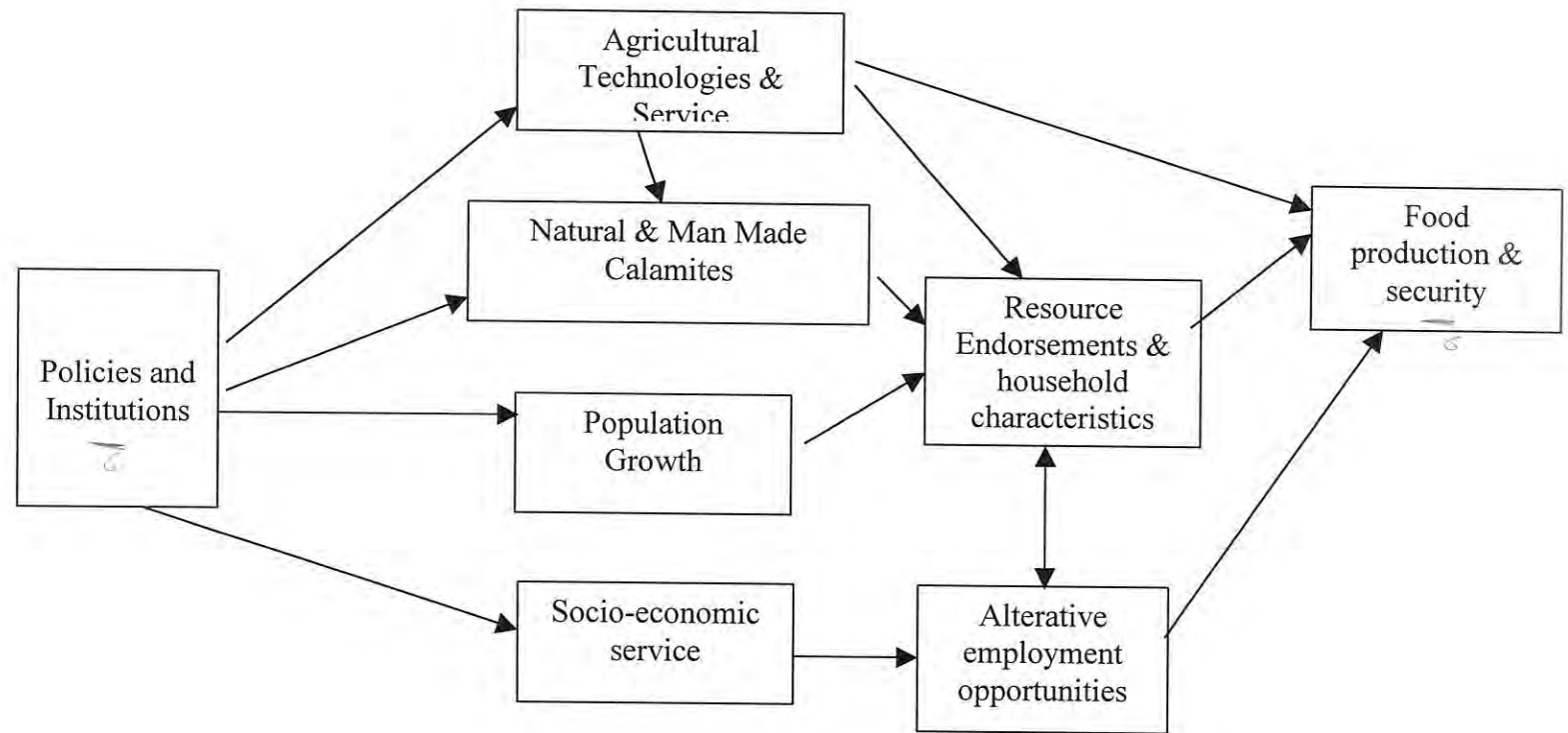
The food security status of the household depends on its food production capacity supplemented by availability and use of alternative sources of income. The capacity of the household to produce food and earn income in turn is determined by its resources endowments (land, labour, skill, oxen, livestock), agricultural technologies and services (extension, improved inputs, credit), and availability of alternative employment options. Moreover, the family characteristic, such as the excess of consumers over its producers has its own burden on the food security status of the family.

The quality and quantity of resources endowments is determined by the factors such as population size, the environment, employed technologies, employment in alternative sources of income, and access to social services (education, health). For example, population growth and environmental hazards (such as rainfall shortage, pest attack, flood) affect the productive capacity and leads to depletion of asset and natural resources. But the development of technologies enable to develop the resources and augment production. Access to income earning employment (such as non-farm and food for work) at least prevents depletion of assets and land diminishing. An access to these socio-economic services (such as education, health, credit) is helpful in improving the quality of human and physical capital and checking the population pressure.

The existence of responsive policies and agricultural institutions are the ultimate determinants of the development of resources and appropriate technologies. In other words, whether the resource endowments of land, labour and livestock are developed to create more human and physical capital or not depends on the policy attention given to the sector and the effectiveness and efficiency of their administrations. The effectiveness and efficiency of the institutions then again is determined on the participatory exercise of the stakeholders and the responsiveness of the institutions to their problems. The educational status of the peasant and its other institutional capacities have crucial role in helping the peasant to actively participate in decisions.

Figure 2-1

The Conceptual Framework



III. DATA AND METHODOLOGY

3.1. The Data Set

The primary data for this study are drawn from Bureau of Planning and Economic Development of Region Tigray conducted in April 2002. In this study, the survey sample size considered is 1162 farming households. The sample size is determined by using the estimated total population in 2001 in the wereda and its agro-ecological distribution into high land (Dega or Weinadega) and low land (Kola). The number of households in the wereda are estimated by dividing the estimated population size to an average family size of a household (i.e. 4.5 persons). Then the sample size is produced by taking 4% of the estimated total number of the households (the sampling unit).

The sample size of each *Tabia* is assigned in proportion to its population size. A stratified sampling technique is adopted in selecting each village in the wereda classified into agro-ecological zones. Then each village in the two agro-ecological systems are selected by a random sampling method. The selection of each sampling unit (household) is conducted by applying systematic sampling method based on the list available in the peasant associations (*Tabia*). The enumerators participated in the data collection are 45 in number. They were trained for five days in Axum (capital city of the zone).

Topics covered include among others, crop production on the year and the previous year, land, livestock, credit, extension, use of improved inputs, practices of farm management,

educations, non-farm and off-farm participations, household characteristics, access to socio-economic services, perception of food security status and problems encountered related to agricultural activity and general livelihood, coping strategies adopted, migration.

Secondary Data: The secondary data required to this study is collected from different sources. In addition to the library work conducted, the following organizations are the sources of the secondary data.

- i. Tigray Region Food Security Desk
 - ii. Tigray Bureau of Agriculture and Natural Resources (BoANR)
 - iii. Disaster Prevention and Preparedness Bureau of Region Tigray
3. Discussions with experts of BoANR and personal observations

An extensive literature review on determinants of food security and agricultural development is considered an essential component of the study. Moreover, the agricultural development experience of the country and the associated problems and the followed policies in the three governments are briefly reviewed.

3.2 Methods of Data Analysis

The household survey data are coded and entered into a computer for analysis. The computer software is Statistical Package for Social Scientists (SPSS). Special emphasis is given to the comparison between the literate and illiterate-headed households in

analyzing the effects of the resource endowments, institutional services and technologies, demographic, and environmental factors. Descriptive analysis such as percentages and mean are used to describe the household characteristics; farm resource endowments; access to agricultural technologies and; crop production in the two consecutive years; involvement in alternative employment opportunities and; encountered problems in food security perceived by the households

The yield of crops by educational status of the head, by access to agricultural services and modern inputs, agro-ecological problems, and terracing practices is computed. Moreover, cross tabulations are used to analyze the mean and percentages of the status of food security perception of the households (in terms of number of months that their income/production can cover) in association to the socio-economic and environmental factors.

The food production capacity of the households in meeting their minimum calories requirement is analyzed in association to the affecting factors using cross tabulations of the percentages and mean of the characteristics. For this purpose, the cereals and pulses produced in the two years are converted to their calories equivalent and the members of the households into adult-equivalent. To analyze the own produced food dependence of the farm households, the own produced food is compared with the food security status perception of the households by using cross tabulation of the monthly quartiles.

Lastly, two multiple linear regression models are employed for each of the food security perception of the households and own calories production as dependent variables. The statistical relationships of these dependent variables and various socio-economic, demographic and environmental factors are examined. The model and the hypothesized effects of the variables are indicated below:

The positively affecting factors are farm resource endowments, access to extension services, improved farm management practices and use of inputs, education and age of head, non-farm activities, etc. On the other hand, negative effects are to follow from large dependency ratio and family size, past famine experiences, involvement in food for work and off-farm activities, etc.

$$Y_i = \sum X_i + e_i$$

Where: Y_i , the dependent variable i.e. the perceived number of months that the households' income/production can cover or the number of months coverage from calories produced by the household per adult equivalent

X_i , represents the independent variables affecting the food production and food access of the household such as educational status, age and sex of head, family size, farm assets, dependency ratio, agricultural services and improved inputs, participation in employment options, and environmental variables.

e_i , is the constant for other affecting factors excluded from the model

IV. DESCRIPTIVE ANALYSIS OF THE HOUSEHOLDS

4.1 Demographic Characteristics of Household

The food security status of the household depends on the contribution that each member has as a producer and/consumer. Consequently, the size and composition of the households are important demographic variables in this study. Furthermore, educational opportunities, sex and age of head of households have essential implication on the access and use of resources. Especially, the literacy status of the heads of the households is assumed to play a key role in food security.

Table 4.1: Sex and Educational Status of Head of Households

	Illiterate		Literate		Total	
	Count	Row %	Count	Row %	Count	Row %
Female	187	83.9%	36	16.1%	223	19.2%
Male	476	50.7%	463	49.3%	939	80.8%
Total	663	57.1%	499	42.9%	1162	100%

Source: 2002 survey

In the sample, from a total of 1162 farming households, only 19.2% of them are headed by female. Among the heads of households, merely 16.1% of the female and 49.3% of the male heads are literate (able at least to read and write).

The high population growth and density in the study area is realized by some of the demographic characteristics. The households have an average of 104% dependency ratio. This implies that for every 100 economically active persons, in average there are 104 economically dependent persons. The productive age group (15-64) comprises only 49.1% while the old aged (65+) is 2.4% of the sample population. The high (48.5%)

proportion of the young age group (0-14) signifies the high growth rate of the population. The dependency ratio exceeds the national average (which is less than 100%). This unquestionably negatively affects the current as well as future food security of the society in the study area.

Table 4.2: Age Distribution by Sex of the Respondents

	Broad age category			Total	
	0-14	15-64	>64		
	Col %	Col %	Col %	Count	Col %
Male	50.6%	48.6%	68.2%	3289	50.1%
Female	49.4%	51.4%	31.8%	3283	49.9%
Total	48.5%	49.1%	2.4%	6572	100.0%

Source: 2002 survey

Moreover, the average family size, dependency ratio, adult equivalent, and labour (in man-equivalent)¹ are computed and their averages are tabulated (Table 4.3). For instance, the average family size of the households is 5.66 persons. Adult-equivalent and dependency ratio are 4.63 and 1.22 respectively. When literate and illiterate are compared, the expected outcome was that households headed by literate would have relatively lower average sizes. However, to the opposite of this expectation, except in man-equivalent, these average sizes are higher in the literate-headed households.

Table 4.3: Family Size by Education and Sex of Head

Family Size Characteristics	Female	Male	Illiterate	Literate	Total
Family size (Mean)	3.81	6.09	5.57	5.77	5.66
Adult-equivalent (Mean)	3.09	5.00	4.63	4.64	4.63
Dependency ratio (Mean)	1.15	1.22	1.12	1.31	1.21
Man-equivalent (Mean)	1.75	2.69	2.58	2.43	2.51
Valid N	223	939	663	499	1162

Source: 2002 survey

¹ Conversion factors for adult-equivalent and man-equivalent refer appendix B

One factor contributing for the relatively larger size of dependency ratio of the literate may be that the literate head is comparatively higher in the lower age group of heads where there are younger children. An attempt of examining the size of average dependency ratio at different age categories of the head is made if age is the intervening variable. It is in the earlier ages of heads that the dependency ratio of the literate is relatively lower. This may be, perhaps, due to late marriage of the literate or this is the literate age group that is using family planning methods since it is better in educational level. In the higher age groups, however, the literate has an average dependency ratio far more than the illiterate.

Table 4.4: Average Dependency Ratio by Age Category of the Head

	Age category of head					Total
	<30	30-39	40-49	50-60	>60	
Illiterate	1.27	1.85	1.24	.85	1.00	1.14
Literate	1.04	1.60	1.53	.90	1.11	1.31
Total	1.12	1.69	1.38	.87	1.02	1.22

Source: 2002 survey

4.2 Resource Endowments

Land Holding Size: Land is the critical resource needed for food access of especially subsistence agriculture. However, the land holding size of the majority of the sample households is severely diminished due to population density. With mere an average size of 0.56 hectare, the distribution of the farming households by their land holding size ranges from 3.0% land less to only 14.7% of the households holding greater than 0.75 hectare. In other words, more than 85% of the farming households cultivate less than .75

hectare. Those having less than half a hectare also constitute 67.1% of the sample households.

Table 4.5: Percentages of Households in Landholding Category by Agro-Ecology, Sex and Educational Status of Head of Household

	Land category					Total
	0	.01-.25	.25-.50	.50-.75	>.75	
	Row %	Row %	Row %	Row %	Row %	Count
Kola	9.3%	8.2%	23.3%	21.8%	37.4%	257
Dega ²	1.2%	32.8%	42.8%	15.9%	7.4%	781
Female	1.3%	46.2%	32.3%	10.8%	9.4%	223
Male	3.3%	21.4%	39.4%	19.9%	16.0%	939
Illiterate	1.5%	23.8%	36.0%	20.8%	17.8%	663
Literate	4.8%	29.3%	40.7%	14.6%	10.6%	499
Total	2.9%	26.2%	38.0%	18.2%	14.7%	1162
Average	0.0	.22	.47	.74	1.32	.56

Source: 2002 survey

Moreover, there is disparity in the landholding size when examining its distribution by location, sex and educational status of the head of the household. Landholding size is in favour of illiterate, male and Kola areas against their counterparts. The female and literate-headed households with holding size of 0.5 hectare and below are 79.8% and 74.8% respectively whilst 61.3% of the households headed by illiterate are in this category. Only 9.4% and 10.6% respectively of the female and literate-headed households have greater than .75 hectare in contrast to 17.8% of the illiterate-headed households.

The sample households are also divided by their agro-ecological location, namely Kola and Dega. Moreover, some of the sample households are not identified by their agro-ecological location. In spite of this drawback, the classification shows important

² Dega represents both Dega and Weinadega

differences between the two locations in resource endowments and other characteristics. In landholding, for instance, households residing in Kola proportionally have more land holding size and more land less as well than that of Dega residents.

Oxen: Oxen ownership is an indispensable productive asset in conducting crop production in the study area. To have a pair of oxen is critically needed for agricultural activities such as plowing, sawing and harvesting activities of the household.

Table 4.6: Ownership of Oxen by Sex & Educational Status of Head of Household

	N	Number of Oxen Owned				
		0	1	2	3	4
Female	223	67.7%	25.6%	6.7%	---	---
Male	939	26.6%	51.5%	20.8%	.6%	.4%
Illiterate	663	39.7%	41.5%	17.9%	.3%	6%
Literate	499	27.7%	53.3%	18.2%	.8%	
Total	1162	34.5%	46.6%	18.1%	.5%	.3%

Source: 2002 survey

Despite to this fact, 34.5% of the farming households are ox less. Households with less than a pair of oxen account 81.1% of the sample. The female-headed households are the worst in this respect, 67.7% and more than 93% of them being ox less and having less than a pair oxen respectively. On the other hand, unlike to land size, the literate-headed households are in a better position regarding ox ownership.

The landholding per adult-equivalent and average holding of farm assets of the households is computed and compared. Though female-headed households have lesser landholding size, they have better holding size in proportion to their family (or adult-equivalent) size than male-headed households. However, comparing the literate and

illiterate-headed households, literate-headed households are highly disadvantaged than illiterate-headed households. This is confirmed by the land-labour and land-adult equivalent ratios indicated on the table below.

Table 4.7: Average Ownership of Farm Assets by Sex and Educational Status of Head and Agro-Ecology

Farm Assets	Female	Male	Illiterate	Literate	Kola	Dega	Total
Land size	.45	.59	.62	.49	.81	.48	.56
Land-labour ratio	.334	.242	.292	.216	.374	.218	.259
Land-adult eqvt	.18	.13	.16	.11	.20	.12	.14
Oxen owned	.39	.97	.81	.92	.94	.83	.86
TLU w/o oxen	.69	1.62	1.35	1.55	1.73	1.34	1.44
Total TLU	.96	2.29	1.92	2.20	2.39	1.92	2.04
N	223	939	663	449	257	781	1162

Source: 2002 survey

Livestock Ownership: Livestock is also the only available wealth of the farm households. It has several advantages and uses such as a source of food (such as meat, milk, butter, egg, etc.), organic fertilizer, cash required in meeting various needs, and as a hedge against possible future risks. The average ownership is 2.04 in Tropical Livestock Unit (TLU)³ including oxen and 1.44 excluding oxen. There are, however, 19.5% of the sample households with no livestock ownership. In a subsistence farm household, this can be taken as one of the indicators of higher vulnerability and poverty. Among the households, the literate are better off while the least with regard to ownership of livestock other than oxen are the female-headed households. Agro-ecologically, households in Kola have in average greater resource endowments including TLU ownership (1.73) than Dega (1.34).

³ For the TLU conversion factor used, refer Table2 in annex2

4.3 Access to Services and Use of Inputs

The farm households employing modern inputs and have the access to credit and extension services are normally expected to be equipped with a better farm management, production techniques and productivities. As shown in the annex Table 1, the use of chemical inputs and access to the services of the sample households in general is relatively large taking account of the low opportunities in the past. More than 47% of the farmers have used either of the chemicals (such as insecticides, herbicides and anti-ailments). The application of fertilizer and improved inputs, the access to extension services, and loan in either or all of the consecutive three years (1990, 1991, and 1992 E.C.) are 69.8%, 80.5.3%, 45.6%, and 47.1% respectively.

The other culturally known farm management practices are terrace construction and manure application. As indicated on the annex table 2, the percentage of households who responded that they conduct manure application and terrace construction are 52.0% and 38.2% respectively. Comparing the literate and illiterate-headed households, the former go over the latter in accessing and employing these services and techniques.

4.4 Sources of Vulnerability and Employment Opportunities

In this section, two important points will be raised: perceived difficulties in food security and the involvement of the households in some of the alternative sources of income/food in supplementing the on farm income or in coping food shortages.

Problems in food security: Above and beyond the broad examination of their resource endowments, it is relevant to make a short account of the issues related to the problems of food insecurity as experienced and perceived by the households. This gives additional information helpful in understanding their situations in the past and present so as to make pertinent analysis. For this purpose, the households are asked about the major problems encountered generally in their food security endeavor. Specifically, some of the relevant questions posed are concerning the current constraints in their farm activities; food shortage experience in the last 10 years and its causes and; their suggested solutions for the food insecurity and associated problems.

Table 4.10: Problems Encountered in the Last 12 Months

	Literate	Illiterate	Total	
	Col%	Col %	N	Col %
Lack of farm assets	13.7%	13.1%	156	13.4%
Labour	2.0%	10.1%	77	6.6%
Land	62.2%	54.8%	674	58.0%
Credit	.4%	.4%	5	.4%
Finance	28.8%	26.9%	322	27.7%
Oxen	24.1%	25.2%	287	24.7%
Erratic rainfall	28.6%	24.7%	307	26.4%
Others	3.4%	4.0%	43	3.7%
No problem	8.9%	9.5%	107	9.2%
Valid N	499	663	1162	

Source: 2002 survey

As the livelihood of the society is utterly dependent on land and natural forces unaided by improved techniques, land shortage and erratic nature of rainfall have become the prime sources of their misfortunes. This is confirmed by the perceived problems and consequent suggested solutions of the sample households. For instance, among the constraints of farm activities of the year under study, land is cited by 58.0% followed by financial problems, rainfall and oxen problems being 28.0%, 26.0% and 25.0% respectively.

It is worth noting that while finance is referred as a problem by second largest number of respondents, credit inaccessibility has been insignificantly mentioned as a problem. In this study, we will have an opportunity of looking roughly to its contributions. This is discussed in the analysis of the perception of food security level and food production of households. But, it calls in depth study on credit accessibility and the peasants' views on its role in solving their problems.

Similarly, concerning the causes of food shortage encountered in the last 10 years, the percentages of the households are 56.5% land shortage, 54.8% erratic rainfall, 28.3% unnecessary rainfall, 22% land infertility (Refer annex Table 3). Other factors have been cited by smaller proportion of the households.

Accordingly, as indicated on annex Table 4, the solutions suggested by the households' concentrate on getting more land (73%), access to irrigation (40.8%) followed by improved supply of modern inputs (22.9%) and improving farm management practices (12.3%). There is no significant disparity between the literate and illiterate in the causes and suggested solutions of food security. However, the complaints and solutions of the literate are more on the quality and quantity of the land and access to technologies.

There are some possible reasons for the emphasis of the literate on these aspects. One may be the comparatively disadvantaged state of the literate in the land size and its quality. But, in addition to this, it may have further implication on the difference between the literate and illiterate in their awareness and willingness to employ technologies. Thus,

relatively higher proportions of the literate demand irrigation as solution. The literates' demand for modern inputs and their application seen above is also proportionally higher.

X

Alternative employment: Participation in non-farm, off-farm and food for work activities are the other alternative sources of income for such areas tormented by land diminution and low productivity. As the farm households have surplus labour and are underemployed in slack seasons, involvement in especially non-farm activities is assumed to enhance their income without largely compromising their farm activities. Activities such as food for work are mainly used as coping mechanisms adopted by the households in facing/perceiving food shortage.

Table 4.13: Involvement in Alternative Sources of Income/Food

		Illiterate	Literate	Total	
		Col %	Col %	Count	Col %
Non-farm	no	94.1%	91.4%	1080	92.9%
	yes	5.9%	8.6%	82	7.1%
Off-farm	no	92.5%	85.0%	1037	89.2%
	yes	7.5%	15.0%	125	10.8%
Food for work	no	54.3%	41.7%	568	48.9%
	yes	45.7%	58.3%	594	51.1%
N		663	499	1162	100%

Source: 2002 survey

Only 7.1% of the heads of households are found to be involved in non-farm activities. In such drought-prone areas, even though the limited involvement in off-farm activities is expected, the insignificant number of participation in non-farm activities testifies the limited capacity and/ access of the farm households to these opportunities. The expected outcome in this regard is the comparatively higher proportion of the literates'

participation. The proportion of the literate is higher in all the alternative sources of income including the coping mechanisms.

The higher proportion of the landless literate and its smaller average holding size is considered if it is the cause for its exceeded participation. Generally the households having lesser holding size are greatly involved. However, involvement of the literate in non-farm is not related to its smaller holding size since the proportion of the illiterate is larger among the landless participants. Therefore, in addition to other factors such as lack of access to land, it is possible to say that education has contributed to the higher proportions of the literates' involvement in, especially, non-farm.

4.5 Crop Production and Yield of Inputs

Similar to other annual crop growing farmers, cereals and pulses are the predominantly harvested crops in Ahferom wereda. Among the cereals, *teff*, wheat, sorghum, and barley are the principal crops in area coverage and total harvest. These crops constitute more than 78.0% of the total production. Except *teff*, these are also the highest yielding crops in the two years. But, though *teff* is the dominant crop accounting more than a third of the total cultivated land, it is the lowest yielding cereal in both years. Unlike to 2000, due to the partial or complete failure encountered by the pulses cultivating farmers, its yield has become the lowest of all the crops in 2001.

In general, the average productivities in the two years are dejectedly low. As indicated on the Table 4.14, the average yields of all crops are 4.5 and 4.1 quintals per hectare

respectively in 2000 and 2001. It has also to be born in mind that out of the 1142 households that responded they have cultivated land for cereals and pulses in 2001, only 1133 have harvested the crops greater than zero.

Table 4.14: Cultivated Land, Production and Yield of Cereals & Pulses

	2000			2001			
	Area	Prd ¹	Yld	N	Area	Prd	Yld
Teff	242.8	943.8	3.9	828	286.3	1101.1	3.8
Barley	73.5	408.4	5.5	344	72.4	341.1	4.8
Wheat	81.3	426.4	5.2	423	90.9	431.8	4.9
Maize	22.3	126.4	5.7	87	18.9	77.5	4.1
Sorghum	88.4	430.6	4.9	211	88.5	346.1	3.9
Zengada	8.9	41.0	4.6	34	9.3	35.5	3.8
Finger Millet	63.4	269.0	4.2	256	71.0	298.6	4.2
Pulses	56.9	245.2	4.3	303	57.2	210.7	2.3
Total	637.6	2890.9	4.5	1142	694.4	2842.3	4.1

Source: 2002 survey ¹Prd=Production Yld=Yield

So, it is not difficult to generalize about the bleak productivity and food production that is far from meeting the minimum food needs of the respondents. The average household requires 9.95 quintals (4.63 adult-equivalent x 2.15 quintals required for each adult-equivalent) of cereals per year. But, the average food production in 2001 in the average cultivated land is only 2.50 (.61 ha x 4.1) quintals. In this case, there is an average of 7.50 quintals (75%) food deficit per household.

An examination of the yield of the crops by educational status of the head of household is made so as to look at the effects of education on intensive use of the land. In this respect, the advantage of education is substantiated by the relatively higher yield differences between the literate (4.4 qt./ha) and illiterate-headed (3.9 qt./ha) households. As indicated

on the table below, the literate demonstrates exceeded productivity per hectare for all crops except *zenghada*.

Table 4.15: 2001 Cultivated Land, Production and Yield of Cereals & Pulses
By Educational Status of Head

	Illiterate			Literate			Total
	Area	Prd	Yd	Area	Prd	Yld	
Teff	179.6	649.3	3.6	106.7	451.9	4.2	3.8
Barley	40.6	186.8	4.6	31.8	154.3	4.9	4.8
Wheat	49.2	221.7	4.5	41.8	210.1	5.0	4.9
Maize	13.2	49.1	3.7	5.7	28.4	5.0	4.1
Sorghum	57.0	214.8	3.8	31.5	131.3	4.2	3.9
Zengada	4.6	23.5	5.1	4.6	12.0	2.6	3.8
finger millet	43.6	171.3	3.9	27.4	127.3	4.6	4.2
Pulses	33.2	119.9	3.6	24.0	90.8	3.8	2.3
Total	420.9	1636.3	3.9	273.5	1206.1	4.4	4.1

Source: 2002 survey

Inputs and Yield of Cereals and Pulses

The possible causes of failures of the technologies are related either to unfitness of the developed technology to the agro-ecological situation, unfortunate environmental events (such as shortages of rainfall), or low capacity of the implementing bodies (extension service and farmers) for its proper application. In this case, since education and extension service are expected to enhance the capacity of the farmer in better use of the inputs and receptiveness of advices, impact of these factors on the contribution of the inputs is further analyzed.

Yield of inputs by educational status: Several points can be observed from the outcomes of the computed yields of the inputs by educational status of the head in the

annex Table 6. Firstly, the technologies in general are not successful in bringing dramatic change in food production. It does not seem that they are even capable of covering their cost. The maximum additional production obtained by adopting the inputs is 0.64 quintal per hectare in the case of fertilizer application. Even there are technologies such as terrace construction with which lower yield is associated. The second is the better productivity of the literate over the illiterate indicated above is not generally for their difference in access to the technologies and services. The literate has more productivity even when both are having the same opportunity.

Further more, the literate and illiterate-headed households differ in the effectiveness of the different inputs. In addition to terracing, extension service and manure application could not be helpful to the illiterate alone in terms of raising productivity. On the other hand, applying insecticides yielded the same for the literate than its average.

Yield of inputs by extension service: In this study extension service incorporates fertilizer application and soil and water conservation. Hence, an examination of the service where it is linked with lower productivity of the technologies has been made. The expected possible causes for the negative association of extension may be its association with terracing. Terracing is usually expected to be conducted for those areas which are highly affected by erosion. So, the anticipated reason was, unless supported by appropriate technologies, the bias of extension service in favour of these areas may be the causes for its negative return.

Table 4.17: Yield of Inputs in 2001 by Extension Services

		Extension Service						Total
		No			Yes			
		Area	Prd	Yld	Area	Prd	Yld	Yld
Fertilizer	no	163.6	606.1	3.70	95.6	351.1	3.67	3.69
	yes	230.8	989.1	4.28	204.2	896.0	4.39	4.33
Terracing	no	271.2	1130.9	4.17	146.8	596.1	4.06	4.13
	yes	123.3	464.3	3.77	153.1	651.1	4.25	4.04
Herbicides	no	236.1	890.7	3.77	191.1	816.0	4.27	4.00
	yes	158.4	704.5	4.45	108.8	431.1	3.96	4.25
Total		394.5	1595.2	4.04	300.0	1247.1	4.16	4.09

Source: 2002 survey

However, the reason for the decreased productivity of farmers getting extension service is found to be different from terracing. Those households constructing terracing with the access of the service got higher yields as compared to those not practicing terracing under the access of extension service. Moreover, when comparison is made about terracing practiced aided and unaided by extension service, it has been turned out to be negative for those who are not assisted by the service. Nevertheless, though the net effect of extension service is positive for the sample households in the year, there are areas in which it is related with depressed yields.

Environmental Factors and Effectiveness of Inputs The disaggregated analysis of the influence of such factors as location, soil infertility and rainfall shortages on the effectiveness of the inputs is made for the year 2001. The altitudinal difference is one factor that may affect the productivity of the inputs. In this regard, yield in Dega exceeds that of Kola by an average of a quintal per hectare with and without the inputs. Moreover, except extension service and application of either of the chemicals, all the inputs have similar proportional effect in both locations. But extensions service in Kola and

application of either chemical in Dega are associated with lower yield than the corresponding households in the same agro-ecology.

Table 4.18: Yield of Inputs in 2001 by Location

		Kola			Dega			Total
		Area	Prd	Yld	Area	Prd	Yld	Yld
Extension	no	142.3	506.5	3.56	200.2	871.3	4.35	4.02
	yes	92.1	304.4	3.30	189.2	864.3	4.57	4.15
Manure	no	82.2	274.6	3.34	194.2	822.9	4.24	3.97
	yes	152.2	536.4	3.52	195.2	912.7	4.68	4.17
Fertilizer	no	137.3	452.7	3.30	107.5	441.5	4.11	3.65
	yes	97.1	358.2	3.69	281.9	1294.1	4.59	4.36
Terracing	no	149.6	521.3	3.49	220.3	1009.4	4.58	4.14
	yes	84.9	289.7	3.41	169.1	726.2	4.30	4.00
Seed	no	86.7	287.5	3.31	63.3	269.6	4.26	3.71
	yes	147.7	523.4	3.54	326.1	1466.0	4.50	4.20
Chemical	no	136.4	445.1	3.26	182.7	820.9	4.49	3.97
	yes	97.5	364.8	3.74	204.1	909.1	4.46	4.22
Total		234.4	810.9	3.46	389.4	1735.7	4.46	4.08

Source: 2002 survey

Erratic rainfall and marginal land (soil infertility and high gradient of the land) are the major agro-ecologically related problems cited by some of the households. The data analysis also confirms the impact of these problems by indicating lower associated yields. As indicated on Table 4.19, farmers responded positive for the prevalence of the problems of shortages of rainfall and/or marginal lands have lower average productivities by .32 and .27 quintal per hectare respectively regardless of the inputs and services.

But the effects of these agro-ecological problems on the effectiveness of the technologies have different meaning. An event of rainfall shortage suddenly happening in the year is expected to affect negatively the farmers applying fertilizer. An appropriately constructed terrace, however, should be helpful for the peasants practicing terracing as

compared to their counterparts. This practice should raise yield of the crops by conserving the fertility and water content of the soil in both cases of soil infertility and an occurrence of rainfall shortage.

Table 4.19: Yield of Inputs by Agro-Ecological Problems

			Fertilizer		Terracing		Total
			no	yes	no	yes	Yld
Marginal land	no	Yld	3.79	4.38	4.18	4.14	4.17
	yes	Yld	3.47	4.20	3.95	3.85	3.90
Rainfall shortage	no	Yld	3.74	4.44	4.19	4.18	4.19
	yes	Yld	3.57	4.06	3.96	3.78	3.87
Total		Yld	3.69	4.33	4.13	4.03	4.09

Source: 2002 survey

In spite of the above expectations, the outcome is mixed. Employing fertilizer in both identified problems, though lower than those without the problem, yielded more. But according to the expectation, the yield of fertilizer in rainfall shortage (4.06 qt/ha) is less than its yield in marginal areas (4.20 qt/ha) and the average yield of the sample (4.09 qt./ha). In the case of terrace construction, however, there is a slight decline in yield which is contrary to the role expected in the employment of terracing in the cited problem areas. Hence, other things being the same, the failure of terracing in realizing better (or at least the same) yields for farmers complaining the same problem and in similar situations is suggestive for its unhelpfulness.

Since terracing for all respondents under extension service is found positive above, its effect in these areas is further analyzed by extension service and educational status of the head of household as shown on annex Table 7 and Table 8. With this respect, the literate applying terracing in the problem areas demonstrate significant improvement when getting the extension service. In both rainfall shortage and soil infertility, the yield of the

literate employing terracing has exceeded its own average when getting the access of the service. In respect to the illiterate, it is better not to conduct terracing in both with and without extension service. Especially, if terracing is practiced under extension service, its yield has significantly diminished

Overall results of the analysis: In the sample in general, the three major observations from the analysis of crop production of the respondents are the disappointing performance of the technologies; the higher productivity of the literate and; the mixed contribution of extension service in raising productivity. Starting with the role of education, each of these points are briefly discussed.

The first point is the vital role of education in increasing productivity of the resource endowments and using the land intensively. The literate has recorded half a quintal or more per hectare than the illiterate. Moreover, a noteworthy point with this regard is the difference between the literate and illiterate in getting benefits from the help of extension service. It is the literate that is able usually to improve its productivity when it gets the access to extension service. In the face of soil infertility and rainfall shortages, for instance, constructing terrace of the literate having access to extension service is found associated with high yielding. The yield of the illiterate, on the other hand, has become lesser when having the opportunity to get the advice of the extension agent.

Though minor, these positive contributions to the literates' food production can be considered as typical indicators of differences in the receptiveness and adoption of the

technologies between literate and illiterate. Conversely, the relative lower effectiveness of the illiterate in terracing and extension service suggests the inappropriate design and information gap (due to whether misunderstanding, lack of good personal relations, lack of trust) between the farmer and extension agent which can possibly be bridged by education.

Secondly, unless they are complimented by other supports, all the technologies so far adopted are far from their capacity to help the farmer to produce sufficient food and attain food security. Especially, technologies such as terrace construction are associated negatively with food production. This testifies the huge labour investment at least could not by its own raise food production. As indicated on the table below, the minimal yield of, especially, the households complaining shortage of rainfall and soil infertility in both years is a strong evidence of the steadiness of the low yield.

Table 4.22: Production and Yield in the Two Years by Agro-Ecological Problems

		Soil infertility		High land gradient		Rainfall shortage		Total
		no	yes	no	yes	no	yes	
1994	Yld	4.15	3.93	4.12	3.26	4.19	3.87	4.09
1993	Yld	4.67	4.13	4.57	3.32	4.65	4.26	4.53

Source: 2002 survey

The third is the mixed association of the extension service with the food production of the sample households. Even though, its average effect is positive in the sample, it was not found to be always the same. When aided by an extension service, the output of the illiterate-headed households has been negatively affected. So, this loss has happened due to probably misunderstanding of the peasant or wrong advice of the extension worker.

V. FOOD SECURITY PERCEPTION AND IT'S DETERMINANTS

5.1 Food Security Status

Introduction: Self-perception of food security level and self-provisioning from own production of the farm households are the bases upon which this study is conducted. This part deals with the perception of the sample households with regard to their food security status. Some socio-economic, resource endowments and environmental factors that determine the level of food security are identified and analyzed in this part.

Here, generally, the level of food insecurity as experienced and perceived by the subjects under study will be examined. For this purpose, the respondents are asked about the extent of their income/production in meeting their annual requirements. First they are requested to rank their food security level by choosing either very small, small, medium (barely sufficient), or sufficient. Then, they are asked about the number of months for which the income/production is sufficient.

Perceived ranking of food security status: As we can see from the table below, 92.9% of the households responded either it is very small or small in meeting their annual consumption needs. It is only 1.5% of them that they perceive they earn/produce sufficiently. Roughly, some disparities in food security level of the households can be observed from their ranking when viewed on the basis of their location and characteristics of the head. There is relatively higher concentration of Dega (61.7%),

female (65.9%), and the literate headed (60.0%) households in responding very small as compared to Kola (56.9%), male (58.1%) and illiterate headed (59.3%) households.

Table 5.1: Perception of Food Security Level by Characteristics of Head and Agro-ecology

	Very small	Small	Medium	Sufficient	Total
	Row %	Row %	Row %	Row %	Count
Kola	56.4%	37.4%	4.7%	1.6%	257
Dega	62.1%	31.4%	5.0%	1.5%	781
Female	65.9%	28.3%	4.9%	.9%	226
Male	58.3%	34.6%	5.5%	1.6%	939
Illiterate	59.4%	33.2%	6.3%	1.1%	663
Literate	60.1%	33.7%	4.2%	2.0%	499
Total	59.7%	33.4%	5.4%	1.5%	1162

Source: 2002 survey

Perceived number of months of food security: The number of months that the sample households are capable of covering their requirement with their income/production makes the striking reality of food insecurity level of the households more vivid. The percentage of households which responded that their income/production is sufficient for only six months or less constitute more than 80% of the sample. Only 6.0% of the sample said that they are capable of having an income/production adequate for 10 months or more.

Table 5.2: Percentage of Households in Covering Annual Consumption from Income/Production by Month Category

	≤3 months	4-6 months	7-9 month	>9	Total
kola	19.1%	57.2%	14.0%	9.7%	257
dega	25.1%	56.1%	13.7%	5.1%	781
female	35.0%	51.1%	9.4%	4.5%	223
male	20.2%	59.2%	14.2%	6.4%	939
illiterate	23.4%	56.4%	12.8%	7.4%	663
literate	22.6%	59.3%	13.8%	4.2%	499
Total	23.1%	57.7%	13.2%	6.0%	1162

Source: 2002 survey

In agreement to their response in ranking their food security status, the advantageous position of especially Kola over Dega and male to female become clearly identifiable in the category of months of the households. But, the difference between the literate and illiterate is difficult to distinguish from their percentages distribution of the above categories of months. In contrast to the literate, the proportions of the illiterate at both extremes is high. Hence, the average month coverage by their income/production is helpful in having some general understanding of all the households. This is tabulated against their perception of food security level on Table 4.3.

Table 5.3: Responded Average Month of Income/Production Can Cover by Food Security Level

	Very small	Small	Medium	Sufficient	Total	
					Mean	N
Kola	4.81	6.24	8.58	12.00	5.63	257
Dega	4.35	5.80	8.54	10.33	5.10	781
Female	3.93	5.48	8.64	7.00	4.63	223
Male	4.61	5.93	8.17	11.33	5.37	939
Illiterate	4.41	5.92	8.67	10.71	5.25	663
Literate	4.55	5.77	7.43	10.90	5.21	499
Total	4.47	5.86	8.25	10.82	5.23	1162

Source: 2002 survey

The response of the households in regard to their food security level and the average number of months is consistent except in the case of female. The average month for those female respondents who said they have sufficient income/production is 7 months which is less than even the female with medium level. The appearing error for the total sample is, however, insignificant as the number of female respondents at this level are not more than two persons. But, it will create bias in considering the female population.

The mean month for which the average annual income/production of the sample is considered by the respondents as sufficient to cover is 5.23 months which is less than half of a year. In this case, the highest average month coverage of income/production is observed for male next to Kola. The households located in Dega (with a mean of 5.10), female (4.63) or literate headed (5.21) are those, according to their response, whose average income is adequate for a time period slightly below the sample mean.

The relatively better position of Kola and male-headed households is statistically confirmed. But in this method of analysis, the association of educational status of head to the number of months covered by income/production is not conclusive. Further analysis of the data is made by further disaggregating the households to identify the associated factors that caused the variance among them.

5.2 Determinants of Food Security Status

Some of the major factors identified by the households as causes of their food insecurity and other associated socio-economic factors are examined along with the perceived average month covered by their income/production. Among these are the farm resources (labour, livestock size, oxen, land); other sources of income (non-farm, off-farm, food for work, belg production), socio-economic factors (educational status, sex and age of head, family size, and dependency ratio); agricultural inputs and services (extension, credit, fertilizer, seeds) and; agro-ecological factors (location, rainfall and soil infertility

problems). This part begins with broad examination of the effect of the cited problems by the respondents and the association of some of the major determinant variables.

Causes of food shortage perceived by respondents

As indicated above, the major problems referred by the respondents as causes of food insecurity are related with land, rainfall and inputs. If these factors have created variations in food security perceptions, the status of the affected households are compared with their counterparts.

Land size and its quality as problem: As shown on the table 4.4, there is a gap between the affected and unaffected households by the problems especially to the literate. Those households referring shortage of land and land gradient as problems in their food security have accordingly lesser average month coverage than their counterparts. For instance, the land gradient caused an average of more than one and half months of difference within the affected and unaffected literate. The effect of soil infertility problem also differs for

Table 5.4: Average Month Covered by Problems of Land and Its Quality

	land shortage		high land gradient		soil infertility		Total
	no	yes	no	yes	no	yes	Mean
illiterate	5.58	4.91	5.26	4.75	5.20	5.42	5.25
literate	5.67	4.88	5.22	4.20	5.24	5.10	5.21
Total	5.62	4.90	5.24	4.64	5.22	5.28	5.23

Source: 2002 survey

the literate and illiterate. It is only the literate headed households that have smaller average month in relation to soil infertility as compared to the other literates. Among these three variables, land shortage is highly significantly affecting the sample

households while the others have insignificant comparative impact due to their insignificant or no influence on the illiterate.

Rainfall shortage, lack of inputs and famine: The other factors pointed out by the respondents, as causes of their food shortage are erratic nature of the rainfall and lack of access to improved inputs. The average month coverage of the sample in association to these troubles and famine experience of the households is assessed on Table 5.5.

The strong negative relation of average month covered and famine experience in the last five years demonstrates that the households have not yet recovered from its impact. Similarly, rainfall shortage is related to lower average month coverage for both literate and illiterate. Nevertheless, in regard to the suggested lack of improved input as a causes, though negatively affecting the literate, there is no difference within the illiterate.

Table 5.5: Average Month Coverage by Famine and Causes of Food Shortage

	Rainfall shortage		Lack of improved inputs		Experience of famine		Total
	no	yes	no	yes	no	yes	Mean
Illiterate	5.40	5.12	5.25	5.25	6.08	4.97	5.25
Literate	5.26	5.16	5.22	5.00	5.94	4.93	5.21
Total	5.34	5.14	5.24	5.13	6.02	4.95	5.23

Source: 2002 survey

In general, problems referred by the respondents as causes of food shortages such as shortages of land and rainfall, and soil infertility confirmed their negative impact on those affected households. Their negative impact is consistent and high especially to the literate-headed households. This may suggest the better capacity of the literate to explain the root causes of its misfortunes. Moreover, the high food shortage of those victims of past famines indicates that they still have not yet recovered from its impact. This is an

evidence of the difficulty of the task of invigorating a society affected by prolonged poverty and food insecurity.

Demographic Determinants and Resource Endowments

Different contributions are expected in making the assessment of the effect of the resource endowments and demographic variables on the food coverage of the households. It is anticipated that the resource endowments greatly contribute to the food security of the respondents. In respect to the demographic variables, the expectation is to observe a growth in food security level that goes along with the mean higher age of head and inversely to family size and dependency ratio. This anticipation emanates from the fact that the experience of the head of household has positive contribution in food security. And, dependency ratio and family size dwindle this capacity or are largely consumers in such land shortage areas.

Averages of demographic and farm assets by covered month category: The broad view of the association of resource endowments and demographic characteristics with the covered month categories is indicated below. The result largely shows the anticipated relationship between the quartiles of months covered and the influencing variables. As illustrated on the table 5.6, the farm resources such as the average land holding size (in hectare), oxen, Tropical Livestock Unit without oxen, and age of head of households are directly related with the month categories. But the other farm resource-labour- tends to increase at the beginning in association to the months coverage but declines latter in the

third (7-9 months) and fourth (>9 months) categories of months. Similar to labour, there is negative association of family size apart to its increase from the first to the second category. Dependency ratio, on the other hand, except for its slight raise indicated at the last category as compared to the third category, shows a declining trend in relation to higher coverage of months by income.

Table 5.6: Farm Resources and Household Characteristics by Covered Months

	Income/production covers category				
	<4 months	4-6	7-9	>9	Total
Family size	5.47	5.80	5.58	5.20	5.66
Dependency ratio	1.30	1.23	1.04	1.19	1.22
Age of head	44.94	46.54	46.94	50.54	46.47
Man-equivalent	2.35	2.57	2.56	2.46	2.51
Land holding	.42	.56	.71	.83	.56
Oxen own	.65	.86	1.05	1.17	.86
TLU w/out oxen	1.04	1.45	1.79	2.12	1.44
Total N	268	670	154	70	1162

Source: 2002 survey

Disregarding the interaction effects that may prevail among them, the outcome of the separately conducted statistical analysis of the above variables ranges from positive to negative significant relations. As mentioned above, the size of farm resources has significant role in food security of the households. The analysis of variance of resources such as land, and livestock unit indicate their highly significant positive relations at all levels. Having one or a pair of oxen is also proved to be considerably linked significantly with higher number of months of food coverage. But the few households having greater than two oxen do not prove their significant difference in their larger average month covered as compared to households having lesser number of oxen.

Table 5.7: Average Month Covered by Dependency Ratio and Family Size

	Dependency ratio category			Family size category			Total
	<.75	.75-1.50	>1.50	<6	6-7	>7	Mean
Illiterate	5.46	5.12	5.08	5.23	5.28	5.22	5.25
Literate	5.77	5.09	4.89	5.24	5.08	5.32	5.21
Total	5.57	5.11	4.99	5.24	5.20	5.27	5.23

Source: 2002 survey

In respect to the demographic variables, given other factors, the negative correlation between the dependency ratio and average month covered confirms the expected outcome especially to the literate. The family size has irregular impact on the literate and illiterate. To the illiterate the average month covered is directly related at the beginning to be inverse at higher family. This is reversed in the case of the literate. In the sample as a whole, however, family size and age of the head do not demonstrate to have a linear relation. Most likely due to other factors discussed below, when both family size and age of head increases, the average number of months coverage declines at the beginning and then increases latter.

By categorizing the demographic variables as influencing factors, the variance is tested statistically. The analysis shows that the family size is not strongly associated with the number of months covered. In the case of dependency ratio, the households having greater than 0.75 dependency ratio (second and third categories of the dependency ratios) as compared to those having 0.75 or less are inversely and significantly related. But the relation of the third and the second categories is positive and insignificant.

The Interaction of Demographic and Farm Assets: As the difference in food security level by and large originates from the disparity in farm resources, the skewed resource distribution in favour of larger families may hide the negative effect of increased family size on food coverage of the households. This is examined and an illustration of the average ownership of land, oxen, and livestock unit by the households represented in each category of family size is indicated on Table 4.8.

Table 5.8: Average Month Covered and Resources Ownership by Family Size

		Family size category				Total
		<4	4-5	6-7	>7	
Month	Mean	5.44	5.10	5.22	5.25	5.23
Land size	Mean	.43	.52	.59	.70	.56
Oxen	Mean	.52	.76	.94	1.15	.86
TLU less oxen		.84	1.22	1.61	2.00	1.44

Source: 2002 survey

It is evident from table 5.8 that the better-off households with larger average family size are accompanied with bigger resource endowments. It is for this reason that there is no significant inverse association of the family size in relation to average months of food coverage.

The effect of the proportions of average family size and resource ownership appear similarly in the relationship of age of head and average month covered. In this regard, a significant positive association of average month covered is confirmed only for age greater than 60 to lesser ages while there is decline denoted up to the age category of 30-40, though insignificantly.

Table 5.9: Average Month Covered and Ownership of Resources by Age Category of Head

	Age category of head					Total
	<30	30-39	40-49	50-59	>=60	
Covered month	5.25	4.91	5.08	5.27	5.71	5.23
TLU less oxen	1.08	1.43	1.53	1.67	1.30	1.44
Oxen	.75	.81	.87	1.00	.78	.86
Land size	.34	.46	.56	.69	.70	.56
Family size	3.55	5.24	6.49	6.96	4.90	5.66

Source: 2002 survey

Moreover, the variation of the average month covered at the different age groups is not necessarily related directly with the ownership resources. Had the observed variations been for these resources alone, the correlation between the months covered and age would have been direct to all until the age groups of (50-59) after which oxen and livestock start declining. The two age groups (30-39 and 40-49) that signified the least average month coverage are not also endowed with lesser resources than that of the age group below 30. This confirms the presence of other influencing factors such as large family size especially for households headed by the middle age categories. Hence, the households with grater family size as compared to their relative share of resources such as land are clearly affected negatively in their food security level. This includes the literate headed households which have in average smaller land holding and larger family size discussed in part three.

The Effects of Agricultural Services and Use of Inputs

The association of the inputs adopted and the average number of months that the households can sufficiently meet their requirement with their income/production is also assessed.

Chemicals and improved seeds: The households employing each of the three major inputs have in average exceeded the corresponding households on table 5.10. However, the positive relation of the inputs is not consistent to all categories of months covered by income/production. In the case of fertilizer and improved seeds, for instance, it is only at one category of households (respectively at 7-9 and <4 months) that they enabled the adopters to exceed their group.

Table 5.10: Average Month by Use of Inputs and Their Month Category

		Covered months category				Total
		≤3	4-6	7-9	>9	
		Mean	Mean	Mean	Mean	Mean
Fertilizer	no	2.50	5.15	7.83	11.06	5.04
	yes	2.48	5.12	7.93	10.81	5.31
Chemicals	no	2.48	5.16	8.05	10.69	5.11
	yes	2.50	5.09	7.79	10.97	5.37
Seeds	no	2.42	5.17	8.03	10.93	5.20
	yes	2.51	5.12	7.87	10.85	5.24
Total		2.49	5.13	7.90	10.87	5.23

Source: 2002 survey

Terracing and manure application: As indicated on table 5.11, the average month has no relation with manure and it has inverse relation with terracing. When looked group wise, both manure application and terrace construction users in the <4 months group have greater average month than their counterparts. In addition to this, though unlike to manure terracing is negatively related in the total sample, it has direct relation for the groups of households in the 7-9 months.

Table 5.11: Average Months Covered and Inputs by Covered Months Category

		Months covered category				Total
		=<3	4-6	7-9	>9	
		Mean	Mean	Mean	Mean	Mean
Manure	no	2.47	5.15	7.90	10.89	5.23
	yes	2.50	5.11	7.89	10.84	5.23
Terracing	no	2.48	5.16	7.82	10.94	5.33
	yes	2.50	5.07	8.00	10.65	5.06
Total		2.49	5.13	7.90	10.87	5.23

Source: 2002 survey

Agricultural services: The other factors are the agricultural services such as extension and credit services. From this analysis, the effect of these services in enhancing the households' food coverage is not definite. Households which got credit in all or either of the consecutive three years have average month less than the sample mean at all categories of average months covered.

As to extension, the average month of those who got its access exceeds the corresponding households. But it should be born in mind that the positive correlation is not uniformly the same for all household in the different categories of months. Moreover, the households in the less than 4 months coverage which were associated positively with manure application and terracing are unfavourably correlated with extension.

Table 5.12: Average Month and Agricultural Services by Month Category

		Months covered category				Total
		=<3	4-6	7-9	>9	
		Mean	Mean	Mean	Mean	Mean
Extension	no	2.53	5.11	7.77	10.89	5.15
	yes	2.44	5.15	8.04	10.86	5.33
Loan	no	2.58	5.16	7.90	10.98	5.39
	yes	2.38	5.09	7.89	10.65	5.04
Total		2.49	5.13	7.90	10.87	5.23

Source: 2002 survey

In sum, the application of the above inputs and access to the services are not unequivocally associated with relatively larger average month of food coverage of the households. Terracing and credit in particular are negatively correlated with the average month for which the households assume they are sufficient in food.

Alternative Sources of Income/food: The involvement of the head in non-farm activities or the participation of any member of the household in off-farm and/ food for work are the other factors that influence the food security level of the households. The contribution of the involvement in these activities are tabulated by categories of months covered and educational status of the head on table 5.13 and table 5.14 respectively.

Table 5.13: Average Month and Alternative Sources by Month Category

		Months covered category				Total
		=<3	4-6	7-9	>9	
		Mean	Mean	Mean	Mean	Mean
Non farm	no	2.50	5.12	7.89	10.84	5.21
	yes	2.35	5.18	7.92	11.13	5.57
Off-farm	no	2.48	5.12	7.90	10.85	5.22
	yes	2.63	5.16	7.86	11.20	5.32
Food For Work	no	2.53	5.18	7.94	10.90	5.24
	yes	2.45	5.08	7.87	10.84	5.23
Total		2.49	5.13	7.90	10.87	5.23

Source: 2002 survey

Except to food for work in which the households involved have almost lower average month with their counterparts, all the alternative sources of income are related with greater average month of the sample households. Moreover, non-farm and off-farm activities show greater averages at all categories bar to their decline in <4 and 7-9 months respectively.

Table 5.14: Alternative Sources of Income and Average Month

		Illiterate	Literate	Total
		Mean	Mean	Mean
Non farm	no	5.26	5.13	5.21
	yes	4.97	6.12	5.57
Off-farm	no	5.24	5.19	5.22
	yes	5.28	5.35	5.32
Food for work	no	5.26	5.18	5.23
	yes	5.23	5.23	5.23
Total		5.25	5.21	5.23

Source: 2002 survey

Nevertheless, this higher relation between the average month covered and the alternative sources of income is almost as a result of the contribution of the literate headed-households which have significant advantage in their involvement, especially in non-farm activities.

Employment and farm resources: Land and labour are the two important farm resources that may lead to the differences in involvement in the activities and/having better capacity of food coverage between the literate and illiterate. Their comparison based on these resources substantiates the superior performance of the literate in the alternative activities. Both literate and illiterate involved in non-farm activities have different proportions of the two resources. In contrast to the literate, the illiterate-headed households participating in non-farm activities have proportionally larger size of land and labour.

In regard to employment of surplus labour, the expected outcome is observed for both categories of households participating in off-farm and food for work. Irrespective of the

degree, both have, though slight, smaller average land holding size. Similarly, households having greater average labour practice food for work.

Table 5.15: Involvement in Alternative Activities and Average Land and Labour

		Illiterate		Literate		Total	
		Land	Labour	Land	Labour	Land	Labour
		Mean	Mean	Mean	Mean	Mean	Mean
Non farm	no	.62	2.57	.49	2.43	.57	2.51
	yes	.64	2.61	.46	2.43	.55	2.51
Off-farm	no	.62	2.58	.51	2.44	.57	2.52
	yes	.60	2.58	.40	2.39	.48	2.47
FFW	no	.64	2.47	.51	2.39	.59	2.44
	yes	.60	2.71	.48	2.46	.54	2.59
Total		.62	2.58	.49	2.43	.56	2.51

Source: 2002 survey

Hence, the latter two activities are contributing in making the households to use their surplus labour. Moreover, the more than mean month coverage of the literate involved in the above activities, especially in non-farm and off-farm is not from its advantage in average land holding size. On the contrary, the literate has smaller land size. In contrast, the illiterates' participation in non-farm activities is accompanied with bigger average land and less than sample mean average month of food coverage.

5.3 Econometric Model for Perceived Food Security Status

So far, the association of the food security status perceived by the households with some of the major demographic, socio-economic, technological and environmental factors have been examined descriptively. The statistical significance of the association also is stated though not demonstrated and tabulated in the body.

However, when several factors are influencing the outcome, its associations with the determining factor obtained from separate analysis may fail from demonstrating the strength of the association. This is because the interaction of the variable with other variables may make its association with the dependent variable to be underestimated or overestimated. In other words, it is not possible to identify distinctly the variables that contribute significantly. So, to get rid of making invalid conclusions, a systematic method of analyzing the combined effect of all the major variables has to be employed.

In this part, therefore, the significance of their influences on food security as perceived by the households will be measured and verified statistically. To this end, multiple linear regression function is estimated to further analyze the significance of the effects of the factors. Several factors are identified as explanatory variables determining the perceived food security status perceived of the peasant households.

The major explanatory variables can be classified, as indicated above, socio-economic factors (such as sex, educational status, age of head of households, family size, dependency ratio); households' farm resource endowments (total land size, number of oxen, livestock in TLU without oxen); agricultural institutions (extension services in fertilizer application and soil and water conservation, credit in all or either of the previous consecutive years); farm management with long-term effect (terracing); agro-ecological factors (soil infertility/high gradient of the land called marginal lands, rainfall shortage as causes of food shortages); involvement in non-farm and/Food For Work and; experience of famine in the last five years.

The Variables in the Model are

Dependent Variable (Y): Perceived food security status in terms of number of months to which the annual income/production is sufficient in meeting the annual requirements of the household.

Independent Variables (X):

Sex of the head of the household (1=male and 0=female)

Educational status of the head of the household (1=yes and 0=no)

Age of head of household

Family size of the household (number)

Dependency ratio

Land holding size (in hectare)

Oxen ownership (number)

Livestock ownership excluding oxen (in TLU)

Involvement in non-farm activities (1=yes and 0=no)

Involvement in off-farm activities (1=yes and 0=no)

Participation in Food For Work (1=yes and 0=no)

Extension Service (1=yes and 0=no)

Credit service (1=yes and 0=no)

Terracing (1=yes and 0=no)

Famine experience (1=yes and 0=no)

Rainfall shortage (1=yes and 0=no)

Marginal land (1=yes and 0=no)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.416	.173	.159	2.1355

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	980.616	18	54.479	11.946	.000
Residual	4683.530	1027	4.560		
Total	5664.145	1045			

COEFFICIENTS

	Unstandardized coefficients		Standardized Coefficients	T	Sig.
	B	Std. Er	Beta		
1.(Constant)	5.160	.421		12.268	.000
educational	5.744E-02	.154	.012	.373	.709
sex	.589	.195	.100	3.017	.003
age	6.633E-03	.006	.038	1.131	.258
family size	-.165	.036	-.155	-4.537	.000
depend ratio	-.164	.090	-.055	-1.825	.068
total land	1.250	.185	.230	6.763	.000
oxen	.413	.102	.132	4.050	.000
TLU	.114	.049	.076	2.319	.021
extension	.331	.137	.071	2.417	.016
terracing	-.362	.143	-.076	-2.526	.012
loan	-.278	.135	-.060	-2.062	.039
non farm	.335	.256	.038	1.308	.191
off-farm	1.113E-02	.220	.001	.051	.960
food for work	.129	.139	.028	.926	.355
Location	2.143E-02	.167	.004	.129	.898
Famine	-.853	.158	-.161	-5.390	.000
marginal land	-1.272E-02	.159	-.002	-.080	.936
rainfall shortage	-.129	.140	-.028	-.921	.357

5.4 Discussion of the Results of the Model

In accordance to the hypothesis, the number of months that the income/production of the households can enable them to cover has decreased when the demographic variables such as family size and dependency ratio of the households increases. This is due to the increasing burden of these factors on the households in terms of food and other needs in such areas with limited land and other opportunities.

The male and literate-headed households, having direct relation with food security status, are found to be with better capacity of bearing the above burdens. This may be due the problems encountered by the female in conducting the different farm activities. The female-headed households have problems of labour, oxen and other resources that may give rise to their disadvantaged position in food security status. On the other hand, though insignificant, the positive association between educational status of the head and the number of months covered by income/production is remarkable. With all the skewed distribution of land size and its quality against the literate, this substantiates the crucial role of education in food security.

As discussed above, there is an increase in perceived food security status with an increase of the farm assets such as land, oxen, and livestock. This confirms the expectation of how these resources determine the livelihood of the farm households. Land and oxen are the two major farm assets without which food production is nearly impossible for subsistence farm households. Livestock ownership also has important direct and indirect

contributions. Directly it is a source of food and cash that can be used to buy food and other items needed. Indirectly, also it is the asset that can be transformed into inputs in food production.

The two agricultural services have mixed associations with the food security status of the households. The access to extension service in fertilizer application and soil and water conservation is associated directly with the perceived food security status. But, households constructing terrace on their farmland or those who got credit access are significantly worse off. Besides, the unfavourable agro-ecological factors (such as low quality of land and rainfall shortage) emphasized by the respondents as causes of their food shortage are confirmed by their negative association.

Moreover, the impact of past experience of disaster has been indicated in the highly negative food security perception of the victims of famine. This is an evidence to the agony of the disasters that they have suffered and the absence of institutions capable of preventing and addressing the problem.

To this the positive association of the involvement in non-farm and off-farm activities may indicate as helpful instruments in minimizing their food shortages. Especially non-farm activity has an important contribution even in promoting their livelihood. But their limited contribution is testified by the insignificant involvement of the farm households in the activities. Rather the large number of households participating in food for work in

time of food shortage indicates its input in assisting them not only in getting food access but also in preventing disasters (at least such as loss of assets).

VI. CONTRIBUTION OF FOOD PRODUCTION TO FOOD SECURITY AND ITS DETERMINANTS

The other major aim of this study is examining the extent of the capacity of the subsistence peasant households to meet their food requirement from their own production. In particular, it is an examination of the contribution of socio-economic factors in using land and other resources productively so as to produce sufficient food. The focus on own food production is justified by the insignificant involvement in market and overwhelming own produced food dependence of the subsistence farmers.

This part will make an examination of food production, its relation with level of food security perceived by the households, and its determinants. For this purpose own produced cereals and pulses in 2000 and 2001 are converted into their calories equivalent (EHNRI, 1968-1997). The 2100 calories (Minimum Recommended) is taken as daily requirements for each adult equivalent of the members of the households.

6.1 Food Production Level

The amount of cereals and pulses produced in quintals per adult-equivalent per year, produced calories per adult-equivalent per day, percentage coverage of the minimum annual calories requirement from own production, and the average number of months that they can fulfil their minimum recommended calories are computed for the two years shown in table 6.1 and table 6.2.

Table 6.1: Production and Coverage of Cereals and Calories in 2001

	Cereals per adult-equivalent per year(qt.)	Calories per adult-equivalent per day	Percent Covered	Number of Months calories cover	
	Mean	Mean	Mean	Mean	N
Kola	.81	763.4	36.4	4.42	250
dega	.55	536.3	25.4	3.11	774
female	.65	628.8	29.9	3.64	216
male	.61	594.0	28.3	3.44	926
illiterate	.64	624.0	29.7	3.62	652
literate	.59	569.3	27.1	3.30	490
Total	.62	600.6	28.6	3.48	1142

Source: 2002 survey

Table 6.2: Production and Coverage of Cereals and Calories in 2000

	Cereals per adult-equivalent per year(qt.)	Calories per adult-equivalent per day	Percent Covered	Number of Months calories cover	
	Mean	Mean	Mean	Mean	N
Kola	.75	740.8	35.3	4.29	221
dega	.62	620.5	29.6	3.59	756
female	.77	660.3	36.2	4.40	212
male	.64	632.7	30.1	3.67	882
illiterate	.68	675.8	32.2	3.92	632
literate	.63	632.3	30.1	3.66	462
Total	.66	657.4	31.3	3.81	1094

Source: 2002 survey

As shown on the tables, the households are highly in short of food production in the two years. In both years, the average food production is less than a third of the 2100 minimum calories requirement per adult per day. In average, the year 2000 is in fact relatively better for all except Kola. Nevertheless, the average percentage of the food produced by the households is merely 28.6% and 31.3% of the minimum requirement in 2001 and 2000 respectively.

In contrast to the minimum requirement of cereals (i.e. 2.15 quintals) per adult-equivalent per year, the amount produced is only 0.62 quintals in 2001 and .66 quintals in 2000. When this is converted to calories equivalent of each crop, the average food availability will be merely 600.6 and 657.4 calories per adult-equivalent per day respectively in 2001 and 2000. Therefore, in meeting the minimum calories requirement, the average months that can be covered by own production are 3.48 and 3.81 respectively in the two years.

The households are categorized into quartiles according to their food production level in covering the minimum requirement from own production. As indicated on the table 6.3, around 58% in 2001 and 50% in 2000 of the sample households failed to exceed even 25% of their daily minimum calories requirements from own production. In both years, less than 6% of them are capable of producing more than 75% of the minimum calories requirements.

Table 6.3: Percentages of Households by Minimum Food Production Category in 2001 and 2000

	Calories covered category 2001				Total
	<25%	25-50%	50-75%	>75%	
	Row %	Row %	Row %	Row %	Count
Illiterate	55.7%	31.0%	7.4%	5.9%	652
Literate	60.0%	30.1%	4.5%	5.3%	490
Total	57.5%	30.6%	6.2%	5.6%	1142
	Calories covered category 2000				Count
Illiterate	47.5%	36.6%	9.9%	5.9%	632
Literate	52.1%	32.9%	9.2%	5.9%	462
Total	49.4%	35.1%	9.6%	5.9%	1094

Source: 2002 survey

6.2 Produced food and Perceived Food Security Status Compared

Despite to the occurrence of slight deviations that are normally expected, the food production of the households corresponds to the perception and response of the households in regard to their food security level. This comparison validates the predominance and importance of the own food production in food security of the farm households and the possibility of estimating their food security situation from own food production.

This is verified by the observed characteristics of perceived food status and own produced food in the two years on table 5.4. Firstly, the productions in the two years have the same trend and distribution among the groups of households. This consistency in trend and distribution justifies the possibility of making an estimation of one with the other. Secondly, there is a steady growth of the average months for which they produced food in the two years along with their perception of food security status. the average month covered from own production of the households ranges from approximately 3 months for those responded very small to around 7 months of households perceiving with sufficient food coverage.

Table 6.4: Average Months Estimated and Covered From Own Produced Food by Perceived Food Security Status

	very small	small	Barely sufficient	sufficient	Total
	Mean	Mean	Mean	Mean	Mean
Perceived month	4.47	5.86	8.25	10.82	5.23
2000	3.29	4.22	6.07	6.92	3.81
2001	2.85	4.00	6.32	6.96	3.48

Source: 2002 survey

Third, when the months covered by own production is compared with the average month that the respondents perceived they can cover with their income/production the computed calories coverage of the two years are lower by only 1.74 and 1.39 months respectively in 2001 and 2000. Considering some factors that will be discussed below, the gap between their perception and the produced food is not large.

Table 6.5: Average Months Covered from Own Produced Food by Categories of Perceived Months That Income/Production Can Cover

	Categories of the Perceived Months				Total
	=<3	4-6	7-9	>9	
	Mean	Mean	Mean	Mean	Mean
Estimated month	2.49	5.13	7.90	10.87	5.23
Month2000	2.71	3.63	5.40	6.72	3.81
Month2001	2.35	3.28	4.94	6.89	3.48

Source: 2002 survey

Fourth, as indicated on table 6.5, the average months 2.35 and 2.71 of food production coverage respectively in 2001 and 2000 of the households who said their income/production is sufficient for 3 months or less is in agreement to their response in both years. Households who perceived food security level of (4-6, 6-9 and >9 months) also are accompanied with respective higher own produced food coverage. The months for which sufficient food is produced by these households are respectively 3.28, 4.94, and 6.89 in 2001 and 3.63, 5.40, and 6.72 in 2000

Lastly, the disaggregated households demonstrate similar distribution in both computed food coverage of the two years and their perceived food security level. The percentage distribution of the households with regard to own produced food seen on table 5.2 is similar to that of their distribution in their perception of food security status and coverage

of months by income/production. For instance, the better off positions of the Kola against Dega and illiterate to literate is similar in both perception of food security level and own food production of the two years.

Deviations and their Reasons: Despite to the similarities discussed above as seen on table 6.5, however, some variations are also observed. Except to the first group of households, the average food coverage from own production of the rest categories is below the minimum average month that ought to be in the respective levels. The third and fourth categories that have average food coverage below the lower boundary (respectively at least 6 and 9 months) of the minimum recommended calories especially are far from meeting the level of food security they responded they can from own production.

Four possible reasons can justify the slight difference between the respondents' perception of food security status and the coverage of food from own production. The first and major reason is related to the living condition of the subsistence-farming households. What the households consider food requirement and the food intake they are adapted to is usually below the minimum recommended calories level. Second, it may be due to low food production of the households in the years under study for reasons such as environmental misfortunes. Third, the other sources of income such as non-farm, off-farm, and food for work are used to bridge partly the gap. The last is the estimation difference that may prevail among the respondents.

In general, despite to these possible causes of variations, two major interrelated points are evident from the comparison of the households' perception of food security with their percentage coverage of the own produced calories. One is the consistent relationship of the variables substantiates the idea of own produced food dependence of the peasant households. It approximates the source of food of the households and gives good reason for the analysis of own food production in food security of the farming households. The second major indication is the limited food production capacity of the households and the consumption level to which they are almost adapted.

This study, in examining the food production of the households and its implication to food security, makes an assessment of its determinants. Hence, in the analysis of the own food production, the indicated potential source of variation between the food production and food security perception of the households are considered. These include the other sources of income (such as non-farm and off-farm) and some of the environmental causes of decline in food production of the years understudy. But other minor causes of difference such as estimation and food intake variation are expected to be handled by the statistical methods.

6.3 Determinants of Own Produced Food

As the indigent livelihood of the peasant households is largely determined by their production capacity, looking at the determinants of own produced food is an indispensable requisite in their food security assessment. As we have seen it in table 5.5

above, the food coverage from own production of the households ranges from less than 25% to greater than 75%. When partly disaggregated, there is variation in performance. We have seen the relatively better performance of especially Kola having 36.4% food coverage to 25.4% of Dega areas. Moreover, the illiterate (29.7%) to literate headed (27.1%) and female (29.9%) to male-headed households (28.3) comparatively have exceeded in their own food coverage.

In this part the effects of the major socio-economic, resource endowments, institutional, and environmental factors are evaluated as grounds for these variations of food at the disposal of the households. The result reveals that the variables have almost the same trend in their effect on food production as that of observed above in the analysis of perception of households about their food security status.

Demographic Characteristics and Food Production

The demographic characteristics such as family size, dependency ratio and age of the head are expected to affect the size of food available at the households' disposal. Other factors remaining the same, family size and dependency ratio are the major factors influencing negatively the average number of months for which the households can produce.

In examining the demographic causes of variations in food production of the sample, the land size per adult-equivalent, and the family size are considered along with the average

month covered by own production in the two years. This practice enables to make comparisons of the effects of these factors.

Family size and dependency ratio: The table below indicates that the bigger calories (more months coverage) of Kola over Dega, female against male and the illiterate to the literate is related with lesser average family size and greater land per adult-equivalent of those at an advantage. Moreover, in terms of land size share per adult-equivalent, they should have produced far more than what is observed. Nevertheless, the average month by which they could exceed the corresponding households is not in proportion to the advantage they have in land size. This suggests also the relatively higher gain is not necessarily related to the efficient and intensive utilization of the land.

Table 6.6: Average Months Covered by Own Food Production in the Two Years and Land-Adult Equivalent Ratio by Household Head Characteristics

	kola	dega	fem le	male	illite rate	litera te	Total
2000 Mean	4.29	3.59	4.40	3.67	3.92	3.66	3.81
2001 Mean	4.42	3.11	3.64	3.44	3.62	3.30	3.48
Familysize Mean	5.60	5.72	3.81	6.09	5.57	5.77	5.66
Land-Adult Mean	.20	.12	.18	.13	.16	.11	.14

Source: 2002 survey

The implication of the increased family size to macro environmental degradation and household food insecurity can also be indicated from table 5.7. In the absence of technological development, the impact of increase in family size and population in the long and medium term can be diminution of land size and environmental degradation. But large family size immediately also dwindles the share of the members of the household from the meager available food.

Table 6.7: Average Month Covered With Produced Food and Land Size by Family Size Category

	Category of family size				Total
	=<3	4-5	6-7	>=8	
2000 Mean	6.83	3.74	3.09	2.60	3.81
2001 Mean	6.00	3.53	2.77	2.52	3.48
Land (ha) Mean	.43	.52	.59	.70	.56

Source: 2002 survey

This case is substantiated by the negative association of the family size and dependency ratio with the average month covered from own production of the sample households. This is found to be true even though the landholding size is in favour of the households with larger family size.

Table 6.8: Average Months Covered with Produced Food and Land by Categories of Dependency Ratio

	Dependency ratio category			Total
	<.75	.75-1.50	>1.50	
2000 Mean	4.33	3.64	3.52	3.81
2001 Mean	4.15	3.24	3.10	3.48
land Mean	.59	.55	.55	.56

Source: 2002 survey

When dependency ratio is associated with the food production, the trend resembles like that of the family size. There is decline in food access of the households that have higher number of dependants. The crucial role that the family size and dependency ratio play in affecting the food access of the household is clearer when the amount of food production is looked by age of the head.

Age of head of households: The expected efficiency attainment with an increase in the age of head of household could not be proved visibly in the food production also. Similar to what is indicated in the discussion of their food security perception above, there is

inverse relationship between age of head and own produced food coverage at the beginning up to 40's and positive at the latter higher age levels in both years.

Table 6.9: Average Months Covered With Produced Food by Age Category

	Age category of head					Total
	<30	30-39	40-49	50-59	>=60	
Perceived month	5.25	4.91	5.08	5.27	5.71	5.23
2000 Mean	5.10	3.44	3.16	3.31	4.92	3.81
2001 Mean	4.83	3.12	2.77	3.11	4.48	3.48
Land-adult Mean	.14	.12	.11	.13	.22	.14
Family size Mean	3.55	5.24	6.49	6.96	4.90	5.66

Source: 2002 survey

The correlation observed signifies, among others, the un-proportionate size of land holding to the increasing family size characteristics of the households headed by the middle age. The age category of 40-49 has the least land holding per adult-equivalent and food coverage from production in both years as compared to others. In the highest age group (>60) family size is smaller and consequently they have the largest food coverage and land per adult-equivalent.

The relative status of the households in the different age groups when compared by the perceived food security status and own produced food in the two years is consistent except the exchange of positions between age groups of 30-39 and 40-49. In the discussion of level of food security perceptions of the respondents, the age group 40-49 has better average perceived month than the group of 30-39. But this is reversed in the own food production of both years.

One possible reason is that the age group of 30-39 has relatively greater land per adult-equivalent which helped them to produce higher food. But the households in the age group of 40-49 also have relatively higher labour and fewer dependants that may allow them to get alternative income sources. Since the age group of 30-39 is younger, it is likely that it will have more children in the unproductive group and less labour. As shown on table 5.10, the labour and dependency ratio are in favour of the 40-49 category.

Table 6.10: Dependency ratio and Labour by Category of Age of Head

	age category				Total
	<30	30-39	40-50	>50	
Dependency ratio Mean	1.12	1.67	1.27	.93	1.22
Man-equivalent Mean	1.59	1.93	2.83	2.99	2.51

Source: 2002 survey

Farm Assets, Technologies and Food

The non-human farm resource endowments and technologies that enhance production possibilities are respectively the basis and means of augmenting the food production. The relation of the average months that the household can cover from own produced food to such factors as land, oxen, improved inputs and employed techniques of production is examined in this part.

Farm assets: Though the majority of the farmers responded positive for use of improved inputs, as the result of the data analysis points out, the technologies failed to unfetter the peasant from the chain of food deficiency and its absolute dependence on land size. Hence, with almost no significant substitute, land and its size are still the principal means of increasing food and the basis of livelihood of the farm households. This is verified by

the negligible or negative contribution of the adopted technologies and strong positive association of the land size and average number of months own produced food can cover of the sample households indicated on following tables.

Table 6.11: Average Month of Own Produced Food Coverage by Land Holding Categories

	Land size category				Total
	<.25	.25-.50	.50-.75 >	.75	
2000 Mean	2.97	3.73	4.29	5.41	3.81
2001 Mean	2.52	3.26	4.03	5.42	3.48

Source: 2002 survey

In regard to the contribution of oxen ownership to the food production, as indicated in table 6.12, the result is mixed. The highest average month of food availability from own production is observed for those owning two oxen. The better performance of the households having a pair of oxen as compared to those having one or none is in accord to the expectation.

Table 6.12: Average Month Covered With Produced Food by Number of Oxen Owned

	Number of oxen owned					Total
	0	1	2	3	4	
2000 Mean	4.06	3.48	4.38	3.82	3.12	3.81
2001 Mean	3.49	3.23	4.28	2.97	4.17	3.48

Source: 2002 survey

Other factors being equal, the functional relation of oxen and food production, however, is irregular. Unexpectedly, the advantage of having one ox to nothing and three or more oxen to lesser numbers is outweighed by other factors. Similarly, in table 5.13, the Tropical Livestock Unit excluding oxen demonstrates a slight decline at the beginning but rises latter surpassing highly the average month for the total sample.

Table 6.13: Months Covered With Food Production by TLU Category

		TLU without oxen category			Total
		<1	1-2	>2	
2000	Mean	3.76	3.55	4.23	3.81
2001	Mean	3.31	3.24	4.08	3.48

Source: 2002 survey

Technologies and food: Even though the yield of these technologies and services have been discussed above, it is instructive to look at their contribution in making a difference by enhancing the food production of the users.

Table 6.14: Average Month Covered with Produced Food by Use of Inputs

		Imprvd seed		Chemicals		Fertilizer		Total
		no	yes	no	yes	no	yes	
2000	Mean	4.17	3.69	3.45	4.14	3.76	3.79	3.81
2001	Mean	3.99	3.36	3.38	3.59	3.62	3.42	3.48

Source: 2002 survey

As shown on table 5.14, the inputs are not always directly associated with higher average months covered from own production. It is only the application of either of the chemicals (herbicides, insecticides and/anti-ailments) that indicate an increase in average month of food coverage from own production in the two years. Fertilizer application, on the other hand, has inconsistent effect providing positive and negative contributions respectively in the former and the second years. But the users of improved seeds have less average food coverage from own production than non-users in both years.

Similar to improved seeds, extension service (on either fertilizer application or soil and water conservation), terracing and credit services (in either or all of the last 3 consecutive) are unfavorably correlated with food size in both years for the sample households.

Table 6.15: Average Month Covered with Produced Food by Use of Services

		Extension		Terracing		Credit		Total
		no	yes	no	yes	no	yes	
2000	Mean	3.90	3.64	3.86	3.66	4.13	3.39	3.81
2001	Mean	3.67	3.26	3.56	3.34	3.72	3.21	3.48

Source: 2002 survey

In general, except chemicals, food production diminished in the sample for those households that have an access to the agricultural services and/or employing the technologies. Even the inputs which have relatively higher yield, indicated above, such as fertilizer and improved inputs are not enabling the using households to have at least the same food coverage as that of non-using the inputs. This fact displays the failure of the inputs to compensate the disadvantage of the employing household either in land size, family size or other unfavourable conditions. Moreover, the interaction effect of the combination of the above inputs was examined to look if the inputs such as terracing could be associated positively when used in combination. But none of the use of the combinations of the inputs resulted better performance to exceed the sample mean.

Agro-ecological factors, inputs, and food production: The analysis of the influence of soil infertility and rainfall shortages on the average food production in terms of months covered by own production is made for both years.

Table 6.16: Average Month Covered with Produced Food by Agro-ecological Factors

		Rainfall shortage		Marginal land		Total
		no	yes	no	yes	
2000	Mean	3.80	3.73	3.73	3.87	3.81
2001	Mean	3.53	3.34	3.40	3.73	3.48

Source: 2002 survey

The data analysis indicates that the households who encountered rainfall shortage in the year got less average months of food coverage. Households complaining soil infertility as a problem, however, exceeded their net food production than the others.

Food Size and alternative employment: As mentioned above unlike to off-farm/food for work activities, the involvements in non-farm activities are expected to be handled largely without influencing negatively the on farm activities. On the contrary, they should enhance food production by supplementing inputs and farm assets from the income earned. The participation on food for work and off-farm activities, on the other hand, are usually the substitutes for farm activities of those households relatively in short of land.

Table 6.17: Average Month Covered with Produced Food by Employment Options

	Non-farm		Off-farm		Food for work		Total
	no	yes	no	yes	no	yes	
2000 Mean	3.75	4.23	3.83	3.59	4.19	3.39	3.81
2001 Mean	3.47	3.57	3.51	3.26	3.84	3.14	3.48

Source: 2002 survey

In the study area, in line to the expectation, involvement in off-farm and food for work are negatively associated with the average number of months for which the own produced food is sufficient to meet the minimum requirement of the households. The non-farm activities, on the other hand, are positively related with the average month produced food can cover in meeting the minimum calories requirement of the household.

Nevertheless, it is the literate-headed households only who have in average direct relation of food production and involvement in non-farm activities. Hence, the relatively larger

non-farm involvement of the literate and its positive correlation with food production displays the vital contribution that education can make in using opportunities for food security.

Table 6.18: Average Month of Produced Food by Employment in Non-Farm

		illiterate		literate		Total
		no	yes	no	yes	
2000	Mean	3.91	3.82	3.52	4.61	3.81
2001	Mean	3.63	3.43	3.26	3.69	3.48

Source: 2002 survey

6.4 Econometric Model for Food Production

To further analyze the association of the different variables that have been discussed descriptively above, a multiple linear regression function is again estimated for the number of months for which own production of 2001 is sufficient to meet the minimum calories. This model is similar to the regression model used in analyzing the perception of the households about their food security status. But in this case some variables that are directly related to the food production of the year such as application of fertilizer, improved seeds, chemicals and manure are included.

The Variables in the Model are

Dependent Variable (Y): Number of months that the households are able to meet the minimum calories requirement from the production of cereals and pulses in 2001.

Independent Variables (X):

Sex of the head of the household (1=male and 0=female)

Educational status of the head of the household (1=yes and 0=no)

Age of head of household (number)

Family size of the household (number)

Dependency ratio

Total land holding size (in hectare)

Oxen ownership (number)

Livestock ownership excluding oxen (in TLU)

Involvement in non-farm activities (1=yes and 0=no)

Participation in Food For Work (1=yes and 0=no)

Participation in off-farm activities (1=yes and 0=no)

Access to extension Service (1=yes and 0=no)

Access of credit service in 1990, 1991, and/1992 E.c(1=yes and 0=no)

Fertilizer application (1=yes and 0=no)

Use of improved seeds (1=yes and 0=no)

Use of either herbicides, insecticides, and/anti-ailments (1=yes and 0=no)

Manure application (1=yes and 0=no)

Terracing (1=yes and 0=no)

Famine experience (1=yes and 0=no)

Rainfall shortage in the year (1=yes and 0=no)

Marginal land (1=yes and 0=no)

Location (1=Dega and 0=kola)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.580	.336	.322	2.5536

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	3381.685	22	153.713	23.572	.000
Residual	6684.117	1025	6.521		
Total	10065.802	1047			

COEFFICIENTS

	Unstandardized coefficients		Standardized Coefficients	T	Sig.
	B	Std. Err	Beta		
1.(Constant)	5.763	.538		10.705	.000
educational	.145	.185	.023	.784	.433
sex	.916	.234	.117	3.916	.000
age	2.936E-04	.007	.001	.042	.967
family size	-.721	.044	-.509	-16.571	.000
depend ratio	-.101	.107	-.025	-.940	.347
landholding	2.426	.226	.329	10.713	.000
oxen	.273	.123	.066	2.216	.027
TLU	.222	.059	.112	3.791	.000
extension	-.195	.166	-.031	-1.174	.241
terracing	-8.321E-02	.174	-.013	-.477	.633
loan	-3.589E-02	.163	-.006	-.220	.826
non-farm	-9.216E-02	.309	.008	-.298	.766
off-farm	7.074E-02	.264	.007	.268	.789
food for work	-.356	.167	-.057	-2.131	.033
Location	-.245	.207	-.034	-1.184	.237
Famine	-.609	.186	-.086	-3.276	.001
marginal land	.348	.191	.048	1.822	.069
rainfall short	-.162	.182	-.023	-.890	.374
manure	.310	.164	.050	1.890	.059
fertilizer	.148	.186	.022	.797	.426
improvd seeds	-.297	.201	-.040	-1.483	.138
chemicals	.271	.164	.044	1.654	.098

6.5 The Result of the Model:

The outcome of the regression function shows that increased ownership of oxen, TLU, land size, male-headed households are positively and significantly related with food production. The other variables with positive correlation are applications of manure, fertilizer and chemicals, educational status and age of head. As opposed to the hypothesis, marginal land and involvement in off-farm activities are the two variables that are unexpectedly positively associated with number of months own produced food can cover, but insignificant.

On the other hand, family size, past famine experience, and participation in food for work are negatively and strongly associated with the number of months the own produced food meets the minimum food requirement of the households. Moreover, there are variables which have negative correlations with the dependent variable such as dependency ratio, credit and extension services, improved seeds, terracing, rainfall shortage, the involvement in non-farm, and being in the highlands.

When the effects of the different variables on the two regression models (on perception of food security status and the food production) of the households are compared, it is clear that the role of the major factors are the same. Both models are affected similarly by the socio-economic variables (such as sex, age and educational status of head of household, family size and dependency ratio); the size of farm assets (land, oxen and TLU); the

undesirable experiences and their consequences (famine and rainfall shortages) and; technologies and service (terrace construction and access to credit service).

The factors which differed in their effects on the dependent variables in the two models are extension service, the marginal land, involvement in non-farm and participation in food for work

Thus, in this model similar to the estimation of the food security status, as the farm assets (land, oxen and TLU) increase the number of months covered by own production also increases. In fact, the positive relation of the farm resources with food security is largely through their contribution in food production. For this reason, households endowed with lesser farm resources have smaller food production and are relatively with severe food insecurity also. For instance, despite to the better land-adult equivalent ratio, the low average ownership of oxen of the female-headed households accompanied with labour shortage perhaps are the causes of their disadvantages.

The demographic variables with the same negative effect on both models are the dependency ratio and family size. The expected increasing food production and food security status of the respondents as age increases is outweighed by increase of these sizes even though higher age groups are also endowed with greater resources.

Moreover, the difficult task of beating the challenge of feeding an increasing family size is evidenced when the superior performance of the literate in productivity is

overwhelmed by the associated larger size of consumers. But its positive correlation with all the unfavourable conditions against the literate (in terms of land and family size) is a prove of the crucial role of education in food security.

As indicated on the descriptive analysis and calculation of yields, the agricultural services and application of inputs have mixed results in their association with the number of months own produced food covers. Credit service is negatively related in both models but the positive correlation of extension service in the food security model could not be consistently demonstrated in food production too. Moreover, the modern inputs (such as improved seeds and fertilizer) which are expected to address the food production problem of the households are not at least substituting shortages of land so as to outweigh the negative effects of other factors.

The low capacity of the country to prevent calamities and to take remedial measure of redressing the effects of past disasters is confirmed in the outcome of both models. The victims of past disasters are highly disadvantaged in food production capacity and food security status. Moreover, rainfall shortage is one of the major causes for the low total production and ineffectiveness of the modern inputs. The idea that non-farm activities are largely employed in time of food shortages is supported by the limited involvement. Similar to food for work, it has also negative association with food production.

PART. VII. SUMMARY AND RECOMMENDATIONS

7.1 Summary

Ahferom Wereda epitomizes the densely populated highlands of Ethiopia where the food production and food security of the people have become severely low by the interplay of population pressure, environmental problems unaided by helpful technologies and alternative employment opportunities. Rather than getting a trend of improvements, the problems are still getting worse off over time.

The major food insecurity indicators confirm this general feature of the wereda. Some of the indicators of the distressed food insecurity of the households are the minuscule average land holding size; the high family size and dependency ratio that further diminishes the land in future; the dismally low total production and yield of crops; the unabated impact of the environmental hazards on the agricultural activities; the poor performance of the introduced technologies; the absence of alternative employment opportunities; and the consequent grave vulnerability and food insecurity of the society.

Some of the findings need to be summarized as follows. According to the perceptions of the households, their annual income/production can sufficiently cover their requirements an average of 5.23 months only. The computed own produced calories also could meet the minimum calories requirements of the members of the households for an average of 3.81 and 3.48 months in 2000 and 2001 respectively.

Certain demographic characteristics and the associated land holding size can display also the high density and growth of population that is beyond the carrying capacity of the wereda. The average family size (which is 5.66 persons) and average land holding size (0.56 hectare) have given raise to the density of more than 10 persons per hectare of landholding of the farming society. The diminished land size accompanied with its average yield of 4.09 quintals per hectare in the year is far below its capacity to sustain the average family size. Furthermore, adding fuel to the already blazing fire of vulnerability, there is fast population growth. This is indicated by the high size of children. The age group of (0-14) years constitutes 48.5% of the total sample.

In addition to the large family size, low productivity is another reasons that make land size to be critical for food production of the farming households. The dismally low productivity slightly exceeds 4 quintals per hectare. Devising and developing helpful technologies have not yet tackled the agro-ecological problems that cause this low productivity. Due to this fact, the majority of the households perceived land shortage, erratic rainfall, and soil infertility as causes of their misfortunes of food shortages and most of them suggested land and irrigation as solutions.

The ownership of resource endowments, access to technologies and agricultural services, and the educational status of the household head are the factors that enhance food production and its security. However, the limited size and quality of the resources owned by the sample households signify the severity of vulnerability and poverty. In terms of

educational status, only 42.3% of the heads of households are literate (able to read and write and above) the balance being illiterate. With regard to ownership of farm assets, the sample households own on average 0.56 hectare of land, 0.86 oxen, and 2.04 livestock in TLU (1.44 TLU excluding oxen). Out of them 3% are landless, 34.5% ox less and 19.5% having no livestock excluding oxen.

Regardless of its appropriateness and proper use, the access of the peasant households to modern inputs and agricultural services is comparatively high. According to their response, 45.6% got an access to extension service in fertilizer application and soil and water conservation. 47.1% got credit service in either of the consecutive three years preceding the year of data collection. Moreover, 69.8%, 80.5%, 47.3%, and 38.2% applied respectively fertilize, improved seeds, either of the chemicals (herbicides, insecticides, and/anti-ailments) and constructed terrace on their farmland.

Despite to these accesses and use of the inputs productivity could not be enhanced. This could be due to the agro-ecological problems in the area such as rainfall shortages and soil infertility and perhaps also the problems associated with the adopted technologies and their applications. From a total cultivated land of 694.4 hectare of cereals and pulses in 2001 crop year, the total production is 2842.3 quintals yielding only 4.09 quintals per hectare. Teff takes more than 40% of the total cultivated land and it is the most low yielding cereal crop which is 3.8 quintals/hectare. Wheat, barley, finger millet, and maize, constituting 36% of the total area, are the four crops the yield of which (4.9, 4.8,

4.2, and 4.1 qt/ha respectively) slightly exceed the grand mean yield of the crops (4.09 qt/ha).

The technologies and services failed in making a difference and bringing an increase in food production that compensates the land shortage of the users. The yield of the access to extension service, application of fertilizer, herbicides, insecticides, anti-ailments, improved seeds, and manure (4.16, 4.33, 4.25, 4.22, 4.31, 4.20, and 4.17 quintals/hectare respectively) are slightly greater than the average yield of the total sample. But the yield of those farmers employing terracing in their farmland is found to be below average. The negative effect of this practice is indicated in its lower yield for illiterate farmers complaining agro-ecological problems (such as rainfall shortages and soil infertility) and constructing terrace.

Moreover, in the crop year under study, access to extension service is found to be alarmingly harmful especially to the illiterate-headed households applying chemicals. This is an indication of how the peasants can be victims of either low quality or poor communication skills of the extension agents with the illiterate peasants. This phenomenon, beyond its immediate negative impact on the food production of the peasant, unquestionably has gross implications in the development process of the sector.

For the above reasons, even though the farming households are absolutely dependent on own production for their food, they are able to cover only an average of 3.48 months or 28.6 % of their minimum annual calorie requirement in 2001. The average calories per

adult-equivalent per day is 600.6 in the year. In addition to this the involvement in non-farm of the heads to supplement their limited food production and relieve the land is almost non-existent. Only 7% of the heads of households involved in the activity with a likely aim of coping the food shortage caused by factors such as lack of land.

The different socio-economic and environmental factors have different effects on food production and food security perceptions of the households. In a multiple linear regression analysis, the farm assets (land, oxen, and livestock) ownership and family size are respectively the major positive and negative determinants of food production and food security status perceived by the households. Inputs such as fertilizer and chemicals are associated positively and insignificantly with food production. On the other hand, some technologies and services do not have positive relation with food production and food security status. The technologies (such as improved seeds and terracing) and agricultural credit have negative correlations. Extension service, however, cannot be consistent in its effect in the two models. It has significant and positive correlation with food security status perceived by the households but insignificantly negative correlation with number of months covered by own production.

The crucial role that education can play in food security is confirmed by the better performance of the literate-headed households. There is relatively higher crop productivity and use of opportunities such as non-farm and food for work by the literate. The literate is able to demonstrate higher productivities for all crops and better yield from terracing under rainfall shortage and soil infertility situations especially when getting

access to extension service. Moreover, the involvement of the literate in alternative employment areas is higher. But the expected lower dependency ratio and family size of the literate was found to be quite the opposite.

7.2 Recommendations

Food security attainment especially in such highly vulnerable areas is a daunting task requiring formulation and implementations of policies, strategies and programs that comprehend all socio-economic and environmental aspects of the society. This calls active involvement of the stakeholders in designing and evaluation of the programs so as to mobilize the available resources and employ them effectively in areas where they are rewarding. On the basis of the findings indicated above, some general areas calling due attention in an effort of improving the livelihood of the society in the vulnerable areas are recommended.

- i. The desperate performance of the crop production and the limited availability of non-farm activities demand an urgent search and expansion of non-agricultural activities or non-crop production. The agricultural activity, especially the crop production has proven its inadequacy to sustain the average family size in terms of land size and productivity. The following are cited as possible options:
 - As the agricultural society is vulnerable to the shortage and erratic nature of rainfall, there is no way of solving its problems without addressing this perennial problem.

Hence, high priority should be given to the development and expansion of irrigation schemes in areas such as horticultural produce.

- Moreover, land use and development and expansion of apiculture should be given due attention. The development of agro-forestry in the non-arable land has a multi-dimensional effect in food security and environmental rehabilitation.
 - Expansion and strengthening the non-farm activities by providing training and credit services can supplement their income and gradually relieve the diminishing landholding size.
 - The establishment and growth of service cooperatives can play central role in addressing the socio-economic problems. In addition to their ability to organize and mobilize the capacities, these institutions defend the interest of the peasant.
 - Strengthening the safety net programs that provide employment opportunities which also can help the development of socio-economic services and facilities
- ii. The expansion of soil and water conservation and extension programs are indispensable components in improving and intensifying the quality and carrying capacity of the land. However, the study gives an insight of a problem associated with the extension service and terracing that has far reaching repercussions in the development process. This suggests the requirement of close monitoring and evaluation (with an active involvement and empowerment of all the stakeholders) of the effectiveness of the service so as to take corrective measures timely.
- iii. The rapid population growth should be given due attention in effectively implementing the population policy by providing especial consideration to these areas.

- iv. Quick attainment of the envisaged objective of food security in general and increasing productivity and expansion of alternative employment activities in particular is unlikely unless supported by education and training of the peasant.
- v. Lastly, attainment of food security badly needs the active involvement of the subjects in designing and evaluating the programs. Active participation of stakeholders promotes flexibility of programs that take immediate corrective measures. However, though it is widely advocated by researchers, practitioners and policy makers alike, it is not yet practiced in countries like ours. Hence, it demands an urgent reversal of the top-down approaches followed in the programs engaged in crop production and expansion of alternative employment areas. The application of direct and indirect coercive measures in enforcing the peasant to implement programs should be given due consideration and corrected. For this purpose it may be indispensable to organize the peasants in associations and cooperatives. Moreover, the availability of many alternative organizations (NGOs and social organizations) may be helpful in expanding options and enhancing the bargaining position of the peasant.

- Abrar Suleiman and Semira Seid, 1999, Recent Macroeconomic Reforms and Performance of the Ethiopian Economy: A Surrey of the Issue, in Tegegne Gebre - Egziabher et al (eds.), 1999, pp.
- Azene Bekele, 2001, Status and Dynamics of Natural Resources in Ethiopia, in Taye Assefa (ed.), 2001.
- Bamberger, Michael, 2001, The Importance of Community Participation, The Development Debates, The World Bank institute, Vol.I
- Befekadu Degefe and Berhanu Nega, 1999/00, Annual Report On The Ethiopian Economy, Vol.I, The Ethiopian Economic Association.
- Belay Demissie, 2000, Some Aspects of Soil and Water Conservation Activities in the Amhara Region, in Feoli, Enrico et al (eds.), 2000, University of Trieste and Addis Ababa University, Trieste
- Berhanu Gebremedhin, et al, 2000, Effects of Stone Terraces on Crop Yields and Farm Profitability: Results of On Farm Research in Central Tigray, in Feoli, Enrico et al (eds.), 2000, University of Trieste and Addis Ababa University, Trieste
- Beyene Tadesse, 2000, "Differential Adoption of Agricultural Technologies: Implications for the Choice between Growth and Equity", Working Paper of Regional and Local Development Studies, Addis Ababa University No1.P1-2 Rural Ethiopia, Addis Ababa
- Biggs, Stephen and Farrington, John, 1990, Agricultural Research and the Rural Poor: A Review of Social Science Analysis
- Bureau of Agriculture and Natural Resources (unpublished, 1995 E.C)

- Burkey, Stan, 1996, *People First: A Guide to Self-Reliant, Participatory Rural Development*, Zed Books Ltd, UK
- Dejene Aredo, 2001, *Agricultural Growth, Population, and Environment Nexus: Highlights of the Debate and Implication for Ethiopia*, in Mulat Demeke et al (eds.), 2001,
- _____, 1999, *Property Right: Theory and Illustration with Respect to Land Tenure in Ethiopia*, in Taye Assefa (ed.), 1999, pp.
- Dercon, Stefan and Krishna, Pramila, 1996, *A Consumption-based Measure of Poverty for Rural Ethiopia in 1989 and 1994*, in Bereket Kebede and Mekonen Tadesse (eds.), 1996, pp.
- Ethiopia Economic Association /Ethiopia Economic Policy Research Institute (EEA /EEPRI), 2002, *A Research Report on Land Tenure and Agricultural Development in Ethiopia*
- Ethiopian Health and Nutrition Research Institute (EHNRI), 1968-1997, *Food Composition Table for Use in Ethiopia Part III*
- Frankenberger, T.R., 1992, *Indicators and Data Collection Methods for Assessing Household Food Security*, UNICEF/IFAD
- Gedion Asfaw, 2001 *Impact of Policy and Institutional Issues on Environmental Resources*, in Taye Assefa (ed.), 2001.
- Getachew Diriba, 1995, *Economy at the Cross Roads: Famine and Food Security in Ethiopia*

- Getachew Minas, 2001, Population Dynamics and Their Impact on Population Growth and Sustainable Livelihood in Ethiopia, in Taye Assefa (ed.), 2001.
- Getachew Olana, 2001, High Food Selectivity: An Overlooked Cause of Food Insecurity in Ethiopia, in Mulat Demeke et al (eds.), 2001.
- J. Bucknall et al, 2000, Environment, The Development Debates, The World Bank Institute, Vol.1
- J. Edgerton, et al, 2000 Participatory Processes in the Poverty Reduction Strategy. The Development Debates, The World Bank Institute, Vol.1
- K.C. Lai, Monitoring and Evaluation of Soil Conservation Projects, Adapted from a Report on the Same Topic of ACC Task Force on Rural Development, UN, IFAD
- Kebede Tesfaye, 2001, The Interconnectedness of Environmental Management and Sustainable Development, in Mulat Demeke et al (eds.), 2001, pp.
- Kifle Lemma Welde-Semayat, 1999, Land Tenure: Legal Aspect and Impact on Sustainable Land Use and Food Security, in Taye Assefa (ed.), 1999.
- M. Claeson, et al, 2000, Health, Nutrition and Population, The Development Debates, The World Bank Institute, Vol.1
- M. Marope, Et al, 2000, Education, The Development Debates, The World Bank Institute, Vol.1
- Masefield, Abi, 2001, "Chronic Food Insecurity in Ethiopia: Looking Through a Livelihood Lens", Food Security and Sustainable Livelihoods in Ethiopia, in Yared Amare (edt.), Forum for Social Studies, Addis Ababa.

- Maxwell, S. and Smith, M., 1992, Household Food Security: A Conceptual Review, UNICEF/IFAD.
- MEDaC, 1999, Survey of the Ethiopian Economy: Review of Post-Reform Developments (1992/93-1997/98), Ministry of Economic Development and Cooperation (MEDaC), Addis Ababa, Ethiopia
- Mitiku Haile and Kindeya Gebrehiwot, 2000, Efforts to Rehabilitate Degraded Lands: Local Initiatives for Planning Resources Management in Tigray, in Feoli, Enrico et al (eds.), 2000, University of Trieste and Addis Ababa University, Trieste
- Mulat Demeke, 2001, Rural Development in Ethiopia: A Review of Concepts, Approaches and Future Directions, in Taye Assefa (ed.), 2001.
- _____, 1996, Non-Farm Activities in Ethiopia: The Case of North Shoa, in Bereket Kebede and Mekonen Tadesse (eds.), 1996.
- Muluneh Weldetsadik, 2001, Impact of Population Pressure on Land Resources As Reflected in Land Use /Land-Cover Changes in Ethiopia: Lessons Learned from West Gurage Land, in Taye Assefa (ed.), 2001.
- N.Singh, Kashi, 1999, Population, Environment and Development Syndrome: Some Interlocking Patterns and the Case of Ethiopia, in Tegegne Gebre - Egziabher et al (eds.), 1999.
- Narayan, Deepa Et al, 2001, Can Any One Hear Us? Voices From 47 Countries, The Development Debates, The World Bank Institute, vol.1 New york
- Original Wolde -Giorgis, 1999, Land Tenure and Institutional capacity, in Taye Assefa (ed.), 1999.

- P. Todaro, Michael, 2000, Economic Development, Addison Wesley Longman, Inc., 7th ed., USA
- Pankhurst ,Richard ,1985 ,The History of Famine and Epidemics in Ethiopia Prior to the Twentieth Century ,Relief and Rehabilitation Commission, Addis Ababa.
- Pausewang, Siegfried, 2002, No Environmental Protection Without Local Democracy? Why Peasants Distrust Their Agricultural Advisers, in Bahru Zewde and Siegfried Pausewang (eds.), 2002.
- _____, 1983, Peasants, Land and Society: A Social History of Land Reform in Ethiopia, Welt forum-Verlag GmbH, München , Köln
- Project, Vulnerability Profile for Tanqua Abergelle Wereda, 2001, Mekelle.
- R. Stevens and C. Jabara, 1988, Agricultural Development Principles Investing in Research, Education, Extension, and Communications
- Ray, Debraj, 1998, Development Economics, Princeton University Press, Princeton, New Jersey
- Rural Development Bureau of Region Tigray, 2002
- Sen, Amartya, 2001, Development As Freedom, Oxford University Press, Oxford,
- Senait Seyoum ,2001 Government Policy on Food Security in Ethiopia: Some Strengths and Weaknesses", Food Security and Sustainable Livelihoods in Ethiopia ed. by Yared Amare , Forum for Social Studies ,Addis Ababa
- Middle brook, Peter and Mengesha Haile, 2001, Integrated Micro Watershed

Development for Enhanced Food Scrutiny In Tigray”, Food Security and Sustainable Livelihood in Ethiopia, ed. by Yared Amare, Forum for Social

Taddesse Berisso, 1999, Agricultural Development and Food Security in Ethiopia: Policy Constraints, in Tegegne Gebre - Egziabher et al (eds.), 1999.

Tarekegn Yibabie, 2001, Enclosing or Individualizing the 'Commons'? The Implementation of two User-rights Approaches to 'Communal' Areas Management in Post-Derg Northern Ethiopia, Alula Pankhurst (ed.), 2001, Forum for Social Studies, Addis Ababa

Teferi Regassa, 1999, Environmental Problems and Policies in Ethiopia: A Survey, in Tegegne Gebre - Egziabher et al (eds.), 1999, pp.

Tekle Gebre, 1999, Public Sector Agricultural Extension Service in Ethiopia: Its Roles in Sustainable Land Use and Food Security, in Taye Assefa (ed.), 1999.

Tesfaye Beshah, 1999, Orienting Agricultural Extension Towards Sustainable Land Use and Food Security in Ethiopia, in Taye Assefa (ed.), 1999.

The Federal Democratic Republic of Ethiopia Food Security Strategy, the Twentieth Century, Relief and Rehabilitation Commission Addis Ababa

Tigray Food security Desk Strengthening Emergency Response Ability, 2002

V. Thomas et al, 2000, Governance and Anticorruption, The Development Debates, The World Bank Institute, Vol.1

W. Ruttan, Vernon and Hayami, Yujiro, 1990, Induced Innovation Model of Agricultural Developments, in Carl.k. Eicher & John M.Staatz (eds.), 1990, 2nd Ed.

- W. Ruttan, Vernon, 1990, Models of Agricultural Development, Carl.k. Eicher & John M.Staatz, 2nd Ed.
- Webb, Patrick and Von Brown, Joachim 199, famine and food Security in Ethiopia,
- World Development Report, 2000 -2001, Expanding Poor People's Capabilities, The Development Debates, The World Bank Institute, Vol.1
- Yared Amare, 1999, Household Resources Strategies and Food Security in Ethiopia: A Study of Amhara Households in Wagda, North Shewa, Vol.1 2002, Addis Ababa.
- Yegremew Adal, 2001, Institutions of Rural Development in Ethiopia Some Observations, in Taye Assefa (ed.), 2001, pp.
- _____, 1999, Rural Organizations in Ethiopia: Their Conditions and Role in Sustainable Natural Resource Use and in Enhancing Food Security, in Taye Assefa (ed.), 1999, pp.
- _____, 1999, The Rural Land Tenure systems in Ethiopia Since 1975: Some Observations About Their Impact on Agricultural Production and Sustainable Land Use, in Tegegne Gebre - Egziabher et al (eds.), 1999, pp.
- Yohannes Mekonnen, 2002, Food Security Problems and Public Actions in Ethiopia, in Gebrehiwot Ageba et al (eds.) 2002, pp. 345-365

Appendix I: Tables from the analysis

Annex Table 1: Access to services and use of improved inputs by educational status of head of households

		Illiterate	Literate	Total	
		Col %	Col %	N	Col %
Extension	no	56.0%	52.2%	622	54.4%
	yes	44.0	47.8%	521	45.6%
Fertilizer	no	30.5%	29.8.2%	345	30.2%
	yes	69.5%	70.2%	798	69.8%
Seeds	no	20.4%	18.4%	223	19.5%
	yes	79.6%	81.6%	920	80.5%
Chemicals	no	53.8%	51.2%	598	52.7%
	yes	46.2%	48.8%	537	47.3%
loan	no	53.4%	52.2%	605	52.9%
	yes	46.6%	47.8%	538	47.1%
Valid N		653	490	1143	100%

Annex Table 2: Farm management practices by educational status of head of households

		Illiterate	Literate	Total	
		Col %	Col %	N	Col %
Manure	no	48.5%	47.3%	549	48.0%
	yes	51.5	52.7%	594	52.0%
Terrace	no	66.0%	56.1%	706	61.8%
	yes	34.0%	43.9%	437	38.2%
Valid N		653	490	1143	100%

Annex Table 3: Causes of food insecurity by educational status of head of household

	Literate	Illiterate		Total
	Col %	Col %	Count	Col %
Erratic rainfall	52.4%	57.4%	619	54.8%
Unnecessary rainfall	28.0%	28.6%	320	28.3%
Pests & insects	1.4%	2.1%	20	1.8%
Land infertility	22.2%	21.8%	249	22.0%
High gradient land	1.2%	3.2%	26	2.3%
Land shortage	62.0%	52.3%	638	56.5%
Lack of farm mgt	3.3%	2.6%	33	2.9%
Traditional farm assets	1.0%	.2%	6	.5%
Lack of improved inputs	4.9%	4.5%	53	4.7%
Others	13.3%	9.2%	124	11.0%
N	482	648	1130	100.0%

Annex Table 4: Suggested improvements as Solutions for the Food Insecurity

	literate		illiterate		Total	
	N	Col%	N	Col %	N	Col %
additional land	366	76.4%	456	70.5%	822	73.0%
irrigation	207	43.2%	252	38.9%	459	40.8%
improving farm mgt	56	11.7%	82	12.7%	138	12.3%
supply of inputs	113	23.6%	145	22.4%	258	22.9%
supply of chemicals	11	2.3%	25	3.9%	36	3.2%
others	52	10.9%	79	12.2%	131	11.6%
N	479		647		1126	

Annex Table 5: Productivity of inputs in 2001 by educational status of head

		Illiterate			Literate			Total
		Area	Prd	Yld	Area	Prd	Yld	Yld
Extension	no	244.1	954.6	3.91	150.3	640.6	4.26	4.04
	yes	176.8	681.7	3.86	123.2	565.5	4.59	4.16
Manure	no	178.0	694.4	3.90	131.4	543.3	4.13	4.00
	yes	242.9	941.9	3.88	142.1	662.8	4.66	4.17
Fertilizer	no	152.4	536.9	3.52	107.0	420.3	3.93	3.69
	yes	268.5	1099.4	4.09	166.6	785.7	4.72	4.33
Terracing	no	271.1	1063.7	3.92	146.9	663.3	4.52	4.13
	yes	149.8	572.6	3.82	126.6	542.8	4.29	4.03
imprd seed	no	95.6	343.6	3.59	56.9	225.3	3.96	3.73
	yes	325.3	1292.7	3.97	216.6	980.8	4.53	4.20
Insecticides	no	263.0	990.8	3.77	162.6	717.0	4.41	4.01
	yes	157.9	645.5	4.09	111.0	489.1	4.41	4.22
Total		420.9	1636.3	3.89	273.5	1206.0	4.41	4.09

Table 6: Yield of terracing and extension in rainfall shortage by education

					Rainfall shortage				Total
					No		Yes		
					Illiter.	literate	Illiter.	literate	
Ex ten sio n	no	terra cing	no	Yld	4.07	4.46	3.78	4.56	4.17
			yes	Yld	3.88	3.86	3.16	3.92	3.77
	yes	terra cing	no	Yld	3.87	4.66	3.49	4.16	4.06
			yes	Yld	4.30	4.72	3.24	4.48	4.25
Total				Yld	4.04	4.44	3.48	4.35	4.09

Annex Table 7: Yield of terracing and extension in marginal land by education

					Marginal land				Total
					No		Yes		
					Illiter.	literate	Illiter.	literate	
Ex ten sion	no	terra cing	no	Yld	3.96	3.93	4.14	4.61	4.17
			yes	Yld	3.87	4.00	3.34	3.64	3.77
	yes	terra cing	no	Yld	3.80	4.73	3.67	3.74	4.06
			yes	Yld	4.13	4.60	3.60	4.61	4.25
Total				Yld	3.94	4.51	3.75	4.13	4.09

Appendix II: Conversion Factors

Labour-equivalent conversion factor by age and sex		
Age group	Gender	
	Male	Female
Below 10	0.0	0.0
10-13	0.2	0.2
14-16	0.5	0.4
17-50	1.0	0.8
Over 50	0.7	0.5

Source: Development Strategies and the Ethiopian Peasantry: Supply response and Rural differentiation. Ababe Haile Gebriel a P.HD thesis submitted to The Hague, The Netherlands, 1999.

Tropical Livestock Unit conversion factor

Type of livestock	Conversion factor
Camels	1.00
Cattle	0.70
Sheep	0.10
Goats	0.10
Horses	0.80
Mules	0.70
Asses	0.50
Pigs	0.20
Chickens	0.01

Source: Ethiopian Economic Association/Ethiopian Economic Policy Research Institute (EEA/EEPRI, 2002) taken from Hans E. Jahnke (1982)

Adult equivalent conversion factor (age, male and female weight)

Age	Male Weight	Female Weight
0	0.33	0.33
1	0.46	0.46
2	0.54	0.54
3-4	0.62	0.62
5-6	0.74	0.70
7-9	0.84	0.72
10-11	0.88	0.78
12-13	0.96	0.84
14-15	1.03	0.86
16-17	1.14	0.86
18-29	1.04	0.80
30-59	1.00	0.82
60+	0.84	0.74

Source: Dercon, S., 1998, Change in poverty in Rural Ethiopia 1989-1995: Measurement, Robustness Tests and Decomposing, Oxford: Centers for the study of African Economics.