

# **Rural Food Security in Tigray, Ethiopia: Policy Impact Evaluation**

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# Rural Food Security in Tigary, Ethiopia: Policy Impact Evaluation

by

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# Abstract

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This study looks on the effectiveness of food security policy in ensuring rural food security and poverty reduction in Tigray region. It also looks the causes of food insecurity and analyzes government policy interventions carried out to address the problem. It was based on secondary data collected from governmental organization and field survey carried out in six Tabia's of the Hentalo Wajerat and Kilte Awelaelo districts in Tigray Region.

The findings of this study show that various and interrelated factors are responsible for the problem of chronic household food insecurity. There are many natural predisposing factors such as drought, environmental degradation and crop pests. Drought and environmental degradation are the most prominent natural causes in the region. Furthermore, socio-economic constraints such as lack of infrastructural services like marketing and transport communications; population pressure and shortage of farmland; and lack of productive assets are the factors contributing to the problem. Past government's misguided economic policies; choice of policies made to use it as a weapon based on the basis of race and ethnicity; and decade's long armed conflict are also the main factors for exacerbating food insecurity in the region. Moreover, the result of the study shows that food insecurity is spatially clustered and factors such as variation in landholding, per capita production and rainfall matter for the spatial clustering of food insecurity; and there is a strong and significant spatial dependency among the food insecure districts.

It is also observed that there are encouraging activities undertaken by the government to address the food crisis. The before-and-after assessments on the food security policy level indicators have shown change or sustained improvement on the main components of food security since the implementation of the policy. Besides, the findings of the logistic regression show that government policy intervention and local leadership significantly contributes to the food security status of households; and the finding further revealed that households covered by food security programs have higher income and better food security status than those households who have not been treated or covered by food security programs.

In general findings of the study reveal that considerable progress has been made throughout Tigray in improving the livelihoods of the rural poor. The activities carried out have succeeded to bring change on the main food security policy level indicators such as food availability and food access. The overall findings of the result shows that the government interventions carried out has been achieving its intended objectives and are effective in improving the lives of the poor and thereby addressing food insecurity.

**Keywords:** policy effectiveness, food insecurity, food availability, food access, livelihoods

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Tagel Gebrehiwot

***Dedicated***  
***to***  
***My late brother***  
***Mao Gebrehiwot***

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## Acronyms

ADC	Austrian Development Cooperation
BOFED	Bureau of Finance and Economic Development
CFS	Committee on World Food Security
DFID	Department for International Development (of U.K)
DPPC	Disaster Prevention and Preparedness Commission
FAO	Food and Agricultural Organization
FBS	Food Balance Sheet
FDRE	Federal Democratic Republic of Ethiopia
FFW	Food for Work
FIVIMS	Food Insecurity and Vulnerability Information and Mapping Systems
FMoFA	Federal Ministry of Foreign Affairs
GDP	Gross Domestic Product
GER	Gross Enrolment Rate
GTZ	German Technical Cooperation
HH	Household
IDA	International Development Association
MDGs	Millennium Development Goals
MOFED	Ministry of Finance and Economic Development
NMA	National Meteorological Agency
RI	Refugee International
SFSA	Syngenta Foundation for Sustainable Agriculture
SL	Sustainable Livelihoods
TFSCO	Tigray Food Security Coordination Office
UN	United Nations
USDA	United States Department of Agriculture
WB	World Bank

# 1. Introduction

## 1.1. Background

Food security and insecurity are terms used to describe whether or not people have access to sufficient quality and quantity of food. They are affected by factors such as poverty, health, food production, political stability, infrastructure, access to markets, and natural hazards.

Improved food security is important for global reduction of hunger and poverty, and for economic development (Parliament 2006). In 2000, world leaders committed themselves to the Millennium Development Goals (MDGs) and one aim of the Millennium Development Goals is to eradicate poverty and hunger, including “to reduce by half the proportion of people who suffer from hunger” between 1990 and 2015. Currently, 820 million people are affected by hunger in developing countries and the numbers of hungry people in the world is growing at a rate of four million a year; and the trend is not falling quickly enough to achieve the goal particularly in Africa and Southern Asia (FAO 2006). It is predicted that many people will not reach their MDG targets particularly in Sub-Saharan Africa where a third of the population is food insecure and there is an actual increase in the number of hungry people due to rapid population (SFSA 2004).

Projections from various sources show that the global food production trend will be positive by 2020 but food insecurity will be persistent. Sub-Saharan Africa is the most vulnerable region with respect to food security and it will be the food insecurity hotspots in 2020. The region’s per capita consumption is projected to decline by 0.5 percent per year through the next decade. By 2008, Sub-Saharan Africa is projected to account for 61 percent of the total gap to maintain consumption and constitutes 79 percent of the total nutritional gap (Shahla and Stacey 1999).

Ethiopia is one of the poorest countries, within Sub-Sahara, with indicators suggesting low levels of development. Some scholars believe that famine incidences caused by drought in Ethiopia goes back to the 11th century and some even refer as far back as 253 B.C. Between 1900 and now about 18 famine periods were registered in the country’s history (Glantz 1987). In most instances famine and hunger are both rooted in food insecurity. It is usual to witness seasonal hunger usually in the months just before the coming harvest. On the surface it appears that erratic weather conditions have repeatedly triggered large-scale cattle and crop failures for the subsistence farmers.

The Ethiopian economy is predominantly agrarian, where almost half of the GDP is contributed by the agricultural sector (45%) and creates employment opportunities for over 85% of the population. Agriculture sector in Ethiopia is characterized by traditional method of farming with little surplus output and is heavily influenced by weather conditions. Only 20% of farm production is supplied to local market while more than 60% of production is used for own consumption, which puts the vulnerable, food insecure households in perspective (Dejene 2006).

In the last three decades food production in Ethiopia has never been sufficient to enable the populations to be food secure. Many Ethiopians live in conditions of chronic hunger with both a low average daily energy supply (kcal/capita/day) of 1880 and a very high (44%) prevalence of under-nourishment (Adnew 2004). The proportion of population in the rural area unable to attain their minimum nutritional requirement is estimated at 52% (Devereux and Sussex 2000). Serious food shortages and high levels of malnutrition continue to affect a large number of people in several parts of Ethiopia.

Recent studies, for instance, have shown that the Ethiopian poor continue to become poorer and a greater number of peoples' livelihood insecurity is ever increasing. An expanding rural population struggles to eke out a living on ever decreasing plots of land whose fertility and productivity continue to decline. In normal years, at least 5 million people out of a population of 70 million are in danger of starvation. That number can rise to over 13 million if drought or other factors cause additional shortfalls in agricultural production (RI 2004).

Most famines and food crisis in Ethiopia have been geographically concentrated in two broad zones of the country. The first consist of the central and northern highlands, stretching from northern Shewa through Wello and Tigray, and the second is made up of the crescent of low-lying agro-pastoral lands ranging from Wello in the north, through Haraghe and Bale to Sidamo and Gamo Gofa in the south (Ramakrishna and Assefa 2002).

Tigray region is one of the regions most affected by recurrent drought famine and food security problems in the country. Many people live in conditions of chronic hunger with a low average energy supply (Devereux and Sussex 2000). The economy is predominantly agrarian where 52 percent of the GDP is contributed by the agricultural sector and 85 percent of the population depends on agriculture for their subsistence (BOFED 2004). In 1999/00, the government of Ethiopia in general and the regional government of Tigray in particular has initiated a food security policy to address the problems of food insecurity in the region which is built around three main pillars: increasing the availability of food through domestic production; ensuring access to food for food deficit households, and strengthening institutional emergency response capabilities. Thus, evaluating the effectiveness of government interventions carried out over the past periods to address the problems of food insecurity is vital in assessing policy goals and as well as planning for future improvements.

### **1.1.1. Justification of the Research**

The above mentioned problems are general to developing countries and findings of this research will contribute to the application of policy design and analysis in policy evaluation which is one of the new research spearhead of ITC especially within the framework of Governance and Spatial Information Management (GSIM) program and evaluating policy effectiveness is also viewed by many as the basic tool for monitoring progress. Despite its usefulness, critical evaluation of policy effectiveness is not carried out in majority of the developing countries like Ethiopia in general and in Tigray region in particular. Therefore, it is in this respect that the researcher intends to carry out a study so as to evaluate the effectiveness of Tigray State Food Security Policy in ensuring food security.

While the datasets and findings of the research is particular to the study area, the evaluation of policy effectiveness approach as well as the results of this study will be largely generic and can be applied elsewhere.

## **1.2. Problem Statement**

Ethiopia is one of the most impoverished countries of the world. A large portion of the country's population has been affected by chronic and transitory food insecurity. The situation of chronically food insecure people is more and more severe. Food security situation in Ethiopia is highly linked up to severe, recurring food shortage and famine, which are associated to recurrent drought. Currently there is a growing consensus that food insecurity and poverty problems are closely related in the Ethiopian context. More than 50 percent of the total population, of whom the majority reside in rural areas, does not have access to the medically recommended minimum average daily intake of 2100 calorie per person per day. The current average figure for the country being not more than 1,700 kcal (FDRE 2002).

(Nigatu 2004) noted that even in years of adequate rainfall and good harvest, people particularly in lowland areas remain in need of food assistance. This clearly shows the deeply entrenched poverty and food insecurity situation in the country irrespective of adequate rainfall. Although drought plays a significant role in triggering food crisis, the difference in household consumption status between “good year” and “bad year” is not enough to claim that drought is the central cause of famine or food insecurity.

The current Ethiopian government has elaborated agricultural development, poverty reduction and food security policies and strategies. During the first stage of agricultural development led industrialization in 1993, for instance, the government envisaged that the focus on agriculture will improve food security conditions. Nevertheless, it has to be acknowledged that the impact of these programs and strategies in addressing the problem of widespread and persistent food insecurity has been limited (ADC 2004).

Data from the Disaster Prevention and Preparedness Commission’s profile show that the drought affected and food insecure population of Ethiopia increased from over 8 % in 1997 to 16% in 2003. The growth rate of food insecure population was 2.6 % until 1991, and increased to 4.6 per annum thereafter (DPPC 2004).

Tigray is one of the regions in Ethiopia worst affected by recurrent drought. State of poverty in the region is among the worst by most social and human development indicators. Government statistics illustrated that the head count poverty index was 61 percent in 1999/2000 implying that more than half of the region’s population was in absolute poverty (MoFED 2002). Moreover, it is evident from the head count index, the depth and severity of poverty that poverty is a rural phenomenon in the region.

The region has challenged in making substantial progress in food security because average yield have remained stagnant over the past decades. Particularly in the drought prone districts, the majority of the rural people can not feed themselves and have thus to depend on food aid for their survival. Governmental reports show that the average annual crop production in the drought prone districts cover only 27 percent of the annual food demand of the household living in these districts (TFSCO 2003). Moreover, the prevalence of child malnutrition is very high, 59% (MoFED 2002).

Realizing the magnitude and severity of food insecurity and livelihood challenges, the government has developed an integrated food security program in 2000, within the framework of the federal government’s overall development and food security policy, to improve the livelihood position of the rural people and thereby address the problem of food insecurity in the region. Thus, different interventions have been carried out over the initial implementation period of the year 2000-2005. But do these policy interventions achieve its intended objectives? Or do the food security policy interventions bring change on the livelihood of the rural people? Or is food insecurity in the region continues to grow? These questions are the rationale for conducting evaluation research to investigate the impacts of the policy which is the centrepiece of the regional agenda.

### **1.3. Research Objectives**

#### **1.3.1. Main Objective**

The main research objective is to analyze the effectiveness of food security policy in ensuring rural food security and poverty reduction in the region.

#### **1.3.2. Specific Objectives**

- To assess the causes and vulnerability situation of households to food crisis in the study area.
- To analyze and evaluate the effectiveness of the policy in ensuring food security.

- To analyze the effect of other external factors on ensuring food security.

## 1.4. Research Questions

### Question for sub-objective 1

- What are the underlying causes of food insecurity?
- Are there spatial dimensions to food insecurity?
- Is there any relation of food insecure areas with low and unreliable rainfall, high population density and low resource endowments?
- What coping mechanisms and survival strategies are used by food insecure households themselves to mitigate the impact of food shortage?

### Question for sub-objective 2

- What is the impact of the policy in alleviating rural food insecurity?
- Do the key policies achieve the intended goal?
- Are the changes in food security outcomes explained by the policy?
- Do key food security program impacts vary across different districts and overtime?

### Question for sub-objective 3

- What is the contribution of other factors in ensuring food security?

## 1.5. Analytical Framework

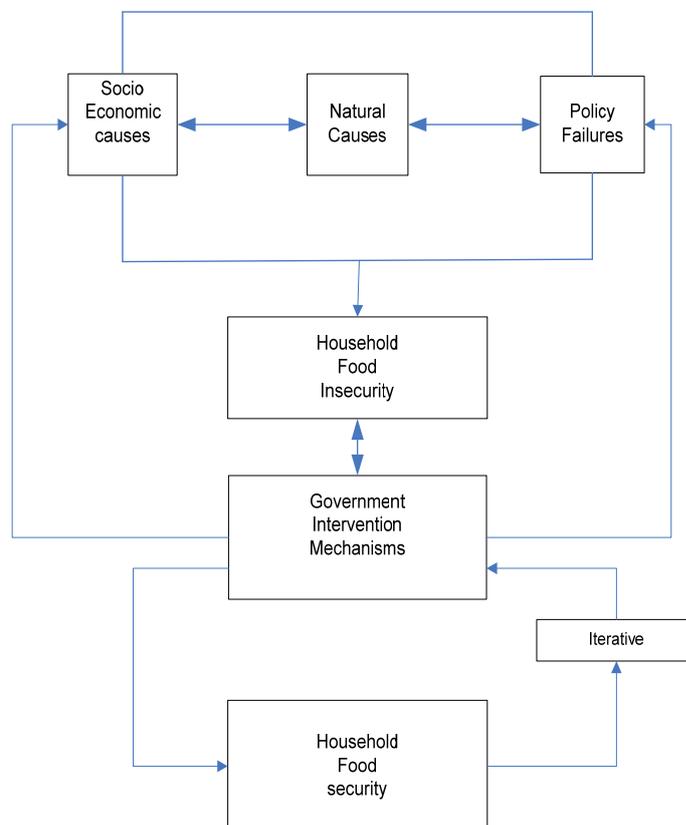


Figure 1 Analytical Framework

## 1.6. Conceptual Framework

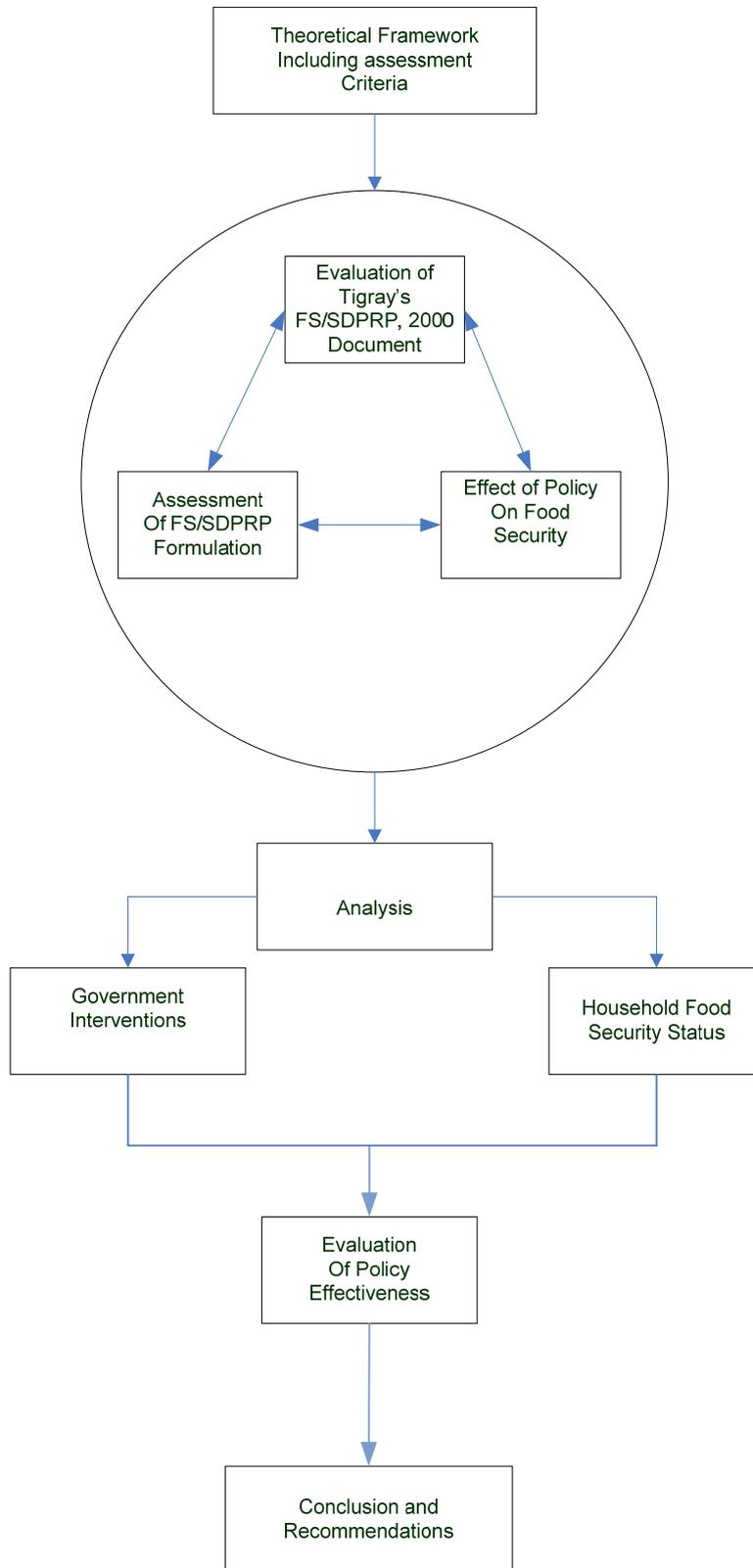


Figure 2 Conceptual Framework

### 1.7. Research Design

This research is initiated with a literature review in relation to the objective. The review is carried out with the purpose of establishing a theoretical framework to more fully understand the concept of food security and poverty; and principles and criteria's used to assess the effectiveness of food security policy. The process of the research approach is illustrated in Figure 3.

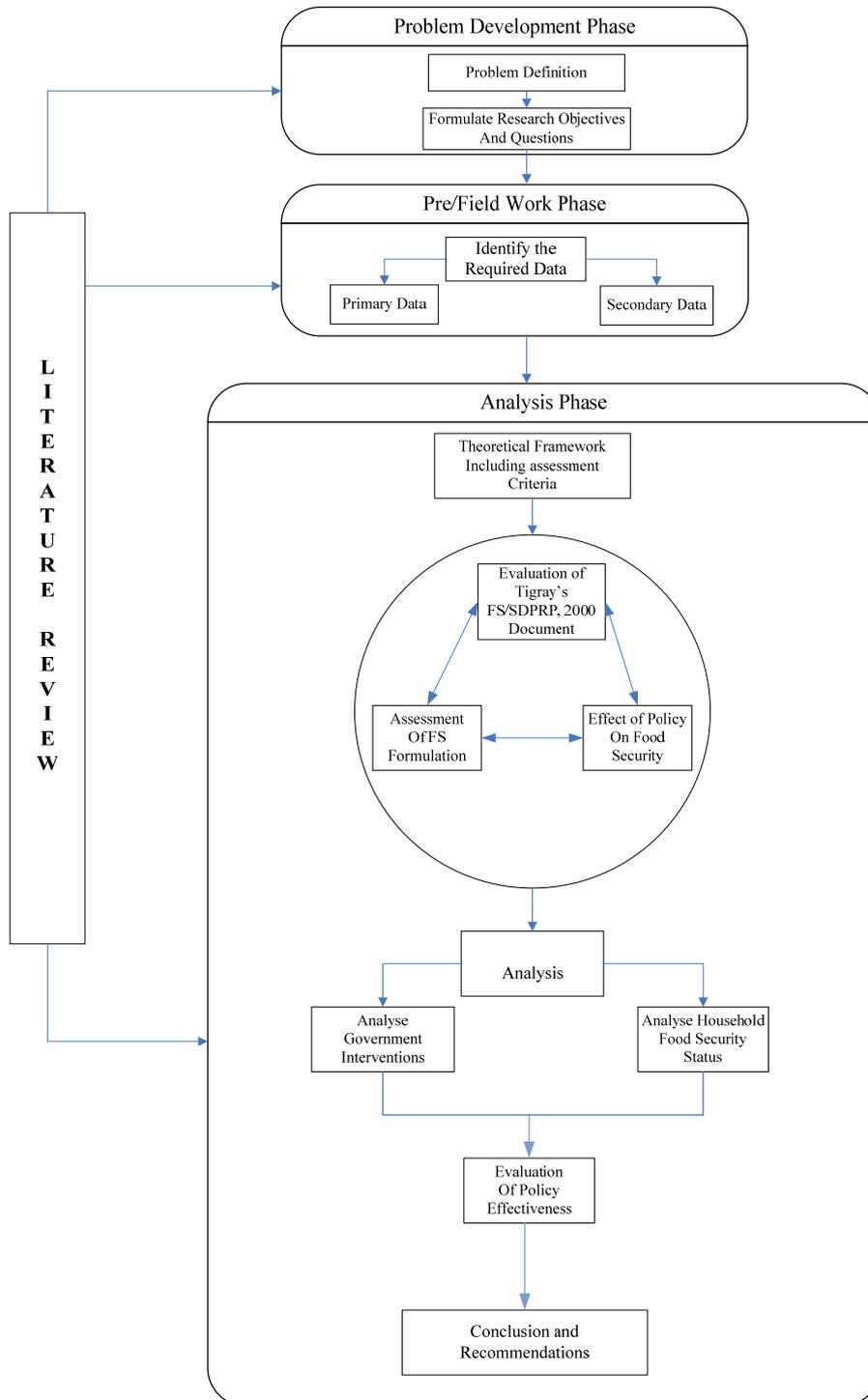


Figure 3 Research Design

## **1.8. Thesis Structure**

The research is organized into eight chapters. The first chapter contains background, the problem statement, significance of the study, objectives of the study, research questions and the research design.

The second chapter deals with the conceptual and theoretical framework along with the literature reviews relevant to the study. It includes the concept of food security, sustainable livelihood framework, policy framework, and policy evaluation.

The third chapter presents a detailed account to the methods carried out to accomplish the research task, including the research techniques, the study area and selection of respondents, sources of data and acquisition methods, method of data analysis, issues of reliability and validity of the research outcome and limitations of the study.

Chapter four presents a brief introduction of the study area. It discusses the physical, demographic and socio economic conditions of Tigray National Regional State including a district profile.

Chapter five, six and seven present the main findings of the research. Chapter five presents' insights into the underlying causes of household food insecurity in the region while chapter six discusses the policy interventions carried out by the government to address problems of household food insecurity and their impact on the main food security policy level indicators. Chapter seven discusses the results of household survey on determinants of food security and household perceptions and opinions on government policy interventions.

Chapter eight concludes by presenting the issues discussed in this paper as well as by providing recommendations for further improvement.

## 2. Theoretical and Conceptual Framework

This chapter deals with concepts and theories that are relevant to the issues to be raised in the research for assessing the impact of policies. It includes the concept of food security, theories of sustainable livelihood framework and policy impact evaluation.

### 2.1. The Concept of Food Security

Different institutions and organization define food security differently without much change in the basic concepts. The roots of concern about food security can be traced back to the Universal Declaration of Human Rights which recognized that “everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food” (UN 1948).

Food security as a concept originated in 1970’s and since then it has been a topic of considerable attention. However, the concept has become more complex due to a shift in the level of analysis from global and national to household and individual levels. In the mid-1970s food security was conceived as adequacy of food supply at global and national levels. This view focused merely on food production variables and overlooked the multiple forces that in many ways affected food access and the definitions of food security focused on aggregate food supplies at national and global levels, and analysts advocated production self-sufficiency as a strategy for nations to achieve food security. The 1974 World Food Conference defined food security as: “availability at all times of adequate world supplies of basic food-stuffs” (United Nations 1975).

Just 12 years after the World Food Conference, however, the World Bank proposed a definition of food security which remains current today, that broadened the emphasis from food availability to include access to food, and narrowed the focus from the global and national to households and individuals: “access by all people at all times to enough food for an active, healthy life” (WB 1986). Since the 1980s, it has been recognized that the achievement of food security requires paying attention to both supply-side and demand-side variables and the concept of food security attained wider attention that shifted from global and national level to household and individual levels.

(Maxwell and Frankenberger 1992) identified many definitions for the concept of food security. However, all definitions emphasis development from macro-level to micro-level concern; from adequate level of supply towards concern to meet the demand; and from short term to a concern of long term (permanent).

Macro-level food self sufficiency does not assure the achievement of food security at household level. According to FAO there are two levels of food insecurity, macro-level (food supply insecurity) and micro-level (food consumption insecurity) (FAO 1996). Food supply insecurity is the national aggregate insecurity which arises when a country is unable to supply its aggregate food requirement either through domestic food production, imports or run-down of stocks and reserves. On the other hand, food consumption insecurity exists when certain individuals or groups cannot gain access to adequate food given their nominal incomes and the price and availability of food. Consumption food insecurity may exist within food supply security, i.e. certain groups of people may lack adequate food although a country may possess adequate aggregate food supplies to meet needs. Thus, national aggregate insecurity entails household food insecurity. On the other hand household insecurity can exist regardless of the status of aggregate national or regional food supply.

USDA (1995) defined food security as, “when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life”. This definition encompasses availability, access and utilization. Food availability is achieved when sufficient quantities of food are available to all individuals. Such food can be supplied through household production, other domestic output and commercial imports or food assistance (USDA 1995).

The World Bank (1996) defined food security as, “year round access to the amount and variety of food required by all household members in order to lead active and healthy lives, without undue risk of losing such access”. This definition also encompasses availability, access and utilization to meet an active and healthy life. Household food security is the application of this concept at family level, with individuals in the household as the focus of concern. This suggests that, an analysis of household food insecurity should also focus on individual household members, i.e. individual level of security within a household or the vulnerability of certain groups of a population due to their social status, labour availability and special nutritional needs such as rural women, malnourished children and the elderly. In some societies for instance, traditional or cultural practices prevent women and children to share the available food with men. Women may have less control of resources than men. Hence, women and children may be more vulnerable (Downing 1996).

The World Food Summit 1996, defines food security as: "Food security exists when all people at all times, have physical and economic access to sufficient, safe and nutritious food to meet the dietary needs and food preferences for an active, healthy life" (FAO 1996). FAO has defined food security not in terms of access to, and availability of food, but also in terms of resource distribution to produce food and purchasing power to buy food, where it is produced.

FIVIMS, similarly, defines food security as a state that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active life. Food insecurity, when people lack this, is seen as due to unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate utilization at household level. It is a complex phenomenon attributable to a range of temporally and spatially varying factors, such as the socio-economic and political environment, the performance of the food economy and the health and sanitation situation (FIVIMS 2003). Besides, vulnerability is also seen to be key, referring to factors that place people at risk of becoming food insecure or reducing their ability to cope (Hussein 2004).

The conceptual framework of food security has progressively developed and expanded along with the growing incidence of hunger, famine and malnutrition in developing countries. In the mid-1970s food security was conceived as adequacy of food supply at global and national levels. This view focused merely on food production variables and overlooked the multiple forces that in many ways affected food access. In the 1980s, the concept of food security attained wider attention that shifted from global and national level to household and individual levels.

An understanding of food security also includes the time dimension, which explicitly describes the intensity and characteristics of household's food insecurity. Food insecurity can be “chronic” or “transitory”. A constant failure to "access" food is distinguished as chronic, while a temporary decline is considered as transitory food insecurity. Chronic food insecurity is a sign of poverty and shows a long-term structural deficit in food production and lack of purchasing power. Transitory food insecurity, on the other hand, implies a short-term variability in food prices, production and income (Maxwell and Smith 1992). Transitory food insecurity is a temporal or seasonal shortage of food because of unexpected factors for only a limited period and it is often triggered by seasonal instability in food supply or availability and fluctuation in prices and incomes (Degefa 2002). Chronic food insecurity can translate into a higher degree of vulnerability to famine or hunger. Repeated seasonal

food insecurity also depletes the assets of the households and exposes them to a higher level of vulnerability.

Food security in general is a concept that integrates a number of important issues the magnitude of which ranges from micro to macro-economics. Its attainment requires an overall consideration in terms of policy and program development in all aspects of the food system. Hence, the success in production and distribution plays an important role in influencing the food security status of an individual, a household or a society at large (Maxwell and Smith 1992). Food security is dependent on the ability of a population to access food in quantities and qualities that satisfy the dietary needs of individuals and households throughout the year.

Moreover, food insecurity is a complex phenomenon attributable to a range of temporally and spatially varying vulnerability factors such as the socio-economic and political environment, the performance of the food economy, care practice and the health and sanitation situation (FIVIMS 2003). These are taken as indicators and key vulnerability factors that causes hunger and that should be monitored in assessing food insecurity (CFS 1999). These are:

**Demographic conditions** create vulnerability when size of population exceeds the carrying capacity of a particular area, and there is limited opportunity for out-migration or for development of physical, social and economic infrastructure so as to provide more productive alternatives to the dominant livelihood systems in the area. High share of rural population in the total may indicate the presence of this kind of vulnerability, particularly if it occurs together with a low level of economic development in rural areas. A high proportion of dependent persons within a family, community, locality or nation also increase the risk of under-nourishment for these persons.

**Environmental conditions** can create chronic vulnerability in several ways. People living in areas where the natural resource base is poor or deteriorating often have limited opportunities for earning their livelihood. Their situation is worsened if acts of man lead to pollution and environmental degradation. Variable climatic and geophysical conditions and biological threats create additional risk. Availability of arable land per capita usually declines with economic development, as more and more land is dedicated to non-agricultural use, and high-technology, high-yielding agricultural practices are introduced on the remainder. However, if availability of arable land per capita is declining solely as a consequence of population growth, without compensating improvements in productivity or in the performance of the national economy, the result is likely to be increasing levels of under-nourishment.

**Economic conditions** can be monitored and assessed at various levels - national, sectoral, or zonal. The structure and performance of the national economy and its components can affect the food security situation of an entire nation through the performance of food markets. These are in turn affected by factors such as food prices, interest rates, inflation rates, labour market conditions, foreign exchange rates, and trade balances. Economic conditions can also create vulnerability and food insecurity if assets and incomes are distributed inequitably among the population, or if public and private sector investment is inadequate or skewed. The degree to which an economy is or is not diversified will often determine whether or not employment and income-generating opportunities exist that would provide sufficient purchasing power to meet basic food needs to all segments of the population. Also, the level of development and the dynamism of economic activities in rural areas often have a strong influence on the level of under-nourishment nationwide.

**Political conditions** can affect food security positively or negatively. Political structures that encourage people's participation tend to reduce vulnerability. But, the presence of civil conflict is a vulnerability factor which can restrict employment and market opportunities, and may lead to loss of assets, destruction of social and physical infrastructure, and even displacement from their homes for

affected households. Armed conflict and civil strife were major sources of food insecurity in the 1990s and will continue to be this century (FAO 2000).

**Social conditions** including both the state of social services and prevailing social attitudes have a very important influence on vulnerability and food insecurity. Where people have access to social infrastructure such as primary education, health care centres and extension services, serious under-nourishment is less likely to be found. People's traditional attitudes influence the kinds of food they eat, the way in which available resources and food are distributed, and the kinds of hygiene, food preparation and caring practices that they most commonly follow. Traditional knowledge offers possibilities for finding innovative solutions to local problems but traditional attitudes may also create a stumbling block in certain circumstances.

**Government Policy:** When ever food shortage or famine occurred in a given country, the government is responsible for failing to prevent the crises. Some researchers claim that government policy failures or inappropriate development strategies are responsible for the recurrence of food shortage and famine or for underdevelopment in a broader context (Bird, Booth et al. 2003).

For example on the cause of the 1977-1988 Ethiopian famine, Clay et al. (1998) note the correlation between famine areas and specific government policies: in Tigray, famine prevailed in areas outside governmental control and under military attack; in Tigray and Wollo, famine occurred in areas of forced resettlement; in northern Bale, Hararghe and Shoa, famine occurred as a result of the government villagization programme and local production disrupted (Downing 1996). Research evidence indicates that inappropriate government policies have become a major barrier to increased food security and economic development in many sub-Saharan African countries (Gebremedhin 1997). The poor farmers, who bear the greatest burden of misguided government policy measures in many African countries, have responded rationally to damaging agricultural policies by turning to private market alternatives. In the 1970s and 1980s, the failures of agricultural policies in Somalia, Ethiopia and the United Republic of Tanzania quickly became apparent in declining output and productivity and a growing inability of these countries to feed their own people (Gebremedhin 1997).

In a nutshell food insecurity is a multi-disciplinary concept which takes into account of technical, economic, social cultural and political dimensions. Thus, the concept of food security must form part of the broader concept of food strategy, which in itself forms parts of a socio-economic development strategy and poverty reduction policies.

## 2.2. Food Security Components

Food security is multi-dimensional having interrelationships with vulnerability indicators; it cannot be captured by any single or specific indicator. It would therefore be important to understand the essential dimensions of food security – Access to food, Availability of food, and Utilization of food. The interactions and combinations of these dimensions represent food security together. Currently Stability is also considered as the fourth component of Food security (GTZ 2006).

**Access** is referred to access by individuals to adequate resources (entitlements) to acquire appropriate foods for a nutritious diet. Entitlements are defined as the set of all those commodity bundles over which a person can establish command given the legal, political, economic and social arrangements of the community in which he/she lives (including traditional rights - e.g. access to common



resources). Securing access to enough food at all times for an active and healthy life is a prime objective of all modern society because of the role played by food in economy, culture, and politics. Food access is largely determined by the ability of households and individuals to obtain food from own production, purchases and other sources, such as gifts, government transfers and food aid.

**Availability** refers to the availability of sufficient quantities of food of appropriate qualities, supplied through domestic production or imports (including food aid). On the supply side, cereal output is the key indicator, as cereals provide about 60% of dietary energy in developing countries. At micro or household level, availability is taken as the capacity of the households to produce the food they need.

**Utilization** is related to utilisation of food through adequate diet, clean water, sanitation, and health care, to reach a state of nutritional well-being for which all physiological needs are met. This brings out the importance of non-food inputs in food security. It is not enough that someone is getting what appears to be an adequate quantity of food if that person is unable to make use of the food because he or she is often falling sick. The dimension of food utilization underlines the importance of such processes, including marketing, storage, processing, cooking practices, feeding practices and nutrition to the attainment of food security.

**Stability** is a very important component of the food security indicator. To be food secure a population, household, or individual must have access to adequate food at all times. They should not be at risk of losing access to food as a consequence of a shock (e.g. an economic or climatic crisis), or cyclically (e.g. during a particular period of the year – seasonal food insecurity). The concept of stability can therefore refer to both the availability and access dimensions of food security.

### 2.3. Sustainable Livelihoods Approaches

Sustainable livelihoods (SL) approaches to food security were developed in the 1980s by different development agencies and organizations and, especially since the 1990s, have been adopted by many as a framework for looking at development issues and addressing food insecurity and thereby poverty. Sustainable livelihood approaches emerged from the growing realization of the need to put the poor and all aspects of their lives and means of living at the centre of development, while at the same time maintaining the sustainability of natural resources for present and future generations.

Livelihood, as understood in SL approaches, can be defined as follows:

*A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (Chambers and Conway 1991).*

Frankenberger has also defined household livelihood security as adequate and sustainable access to income and resources to meet basic needs including adequate access to food, potable water, health facilities, educational opportunities, housing, time for community participation and social integration (Frankenberger and McCaston 1998). The primary objective of the livelihood framework approach is to understand how wider policies, institutions and processes affect local livelihoods. Thus, policies, strategies and their implementation should recognise local differences, and must identify local priorities to deal with so that they can impact positively and bring desirable outcomes, such as increased resilience to disaster risks, and increased food and livelihood security.

Ashley and Carney (1999) pointed out that the livelihood approach is a holistic approach about the vulnerability context, livelihood assets, structures and processes, livelihood outcomes and strategies. The vulnerability context describes trends and variability in those factors that affects and disrupts different aspects of livelihoods. The vulnerability context refers to the group of factors in the external

environment which affects people’s susceptibility to food and livelihood insecurity. It includes trends and shocks. Trends, for example, may include population pressure, environmental degradation, lack of rainfall, etc. Shocks refer to factors like crop or livestock pests and diseases, illness, conflicts, etc. Thus it is important to consider such kind of trends and shocks that make people vulnerable to food and livelihood insecurity.

According to Carney (1998) livelihood assets are the means of production available to a given individual, household or groups that can be used in their livelihood activities. These assets are the basis on which livelihoods are built. The greater and more varied the asset base, the higher and more durable the level of the social security (Ashley and Carney 1999). Carney (1998) further noted that, there are five dominant forms of livelihood assets arranged in a pentagon. These are: natural capital (the natural resource stock), social-political capital (networks, membership of groups, and access to wider institutions of society), human capital (the skills, knowledge, good health), Physical capital (the basic infrastructure and production equipment), and financial capital (savings, supplies of credit and other financial resources). The Vulnerability context frames the external environment in which people exist and the relationships is showed in Figure 4 below.

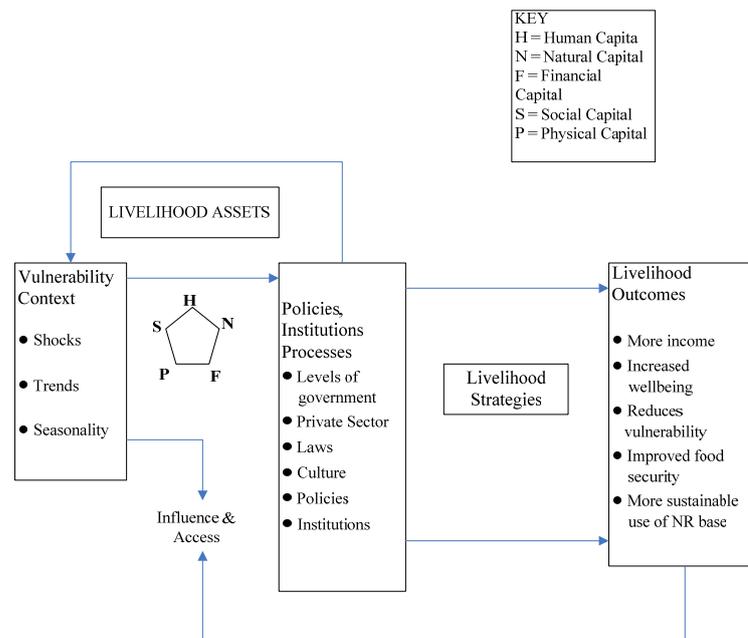


Figure 4 DFID’s Sustainable Livelihoods Framework, adopted from Netherlands, P. (2006)

Structures and processes are the legal, political, social, economic and institutional environments which link people and places in the regional, national and global system. This includes the nature and operation of government which has both direct effects and indirect impacts, the structure and strength of civil society, those non-state institutions and organizations that also regulate social and economic processes, the operation of markets and so on (Blaikie and Soussan 2000).

Institutional and organizational processes determine access to livelihood assets and are central to people’s livelihood strategies and outcome. The nature and operation of the government in this study will include the impact of policies on people’s access to resources, policies and strategies for food and livelihood security and their implementation processes.

One of the key contribution of Sustainable livelihood approach can make to policy analysis is its focus on the livelihoods of the poor: “An analysis of policy for sustainable livelihoods (SL) requires an understanding of the livelihood priorities of the poor, the policy sectors that are relevant to them, and

whether or not appropriate policies exist in those sectors. The policy priorities of poor people will be realized more effectively if they have the capacity to articulate their demands and influence the policy process” (Karl 2002) .

The sustainability of livelihoods raises many questions. These fall in to two groups: whether a livelihood is sustainable environmentally, in its effects on local resources and other assets; and whether it is sustainable socially, that is, able to cope with stress and shocks, and retain its ability to continue and improve. Sustainability is a function of how assets and capabilities are utilized, maintained and enhanced so as to preserve livelihoods (Chambers and Conway 1991). Most conventional thinking equates sustainability with preservation or enhancement of the productive resource base, particularly for future generations. The question here is whether livelihood activities maintain and enhance, or deplete and degrade the local resource base.

Social sustainability refers whether a human unit (individual, household or family) can not only gain but maintain an adequate and decent livelihood. This has two dimensions, one negative, and one positive. The negative dimension is reactive, coping with stress and shocks; the positive dimension is proactive, enhancing and exercising capabilities in adapting to, exploiting and creating change, and in assuring continuity.

Thus, policies, strategies and programmes for household food and livelihood security must recognize that peoples have different strategies. They should logically incorporate people’s own definition of desirable outcomes; what sort of outcomes the poor aspire to achieve; and they must clearly sort out local specific constraints and strengths and be built upon the existing capacities. In a livelihood framework the active participation of the people is therefore also central.

## **2.4. Policy Impact Evaluation**

An impact evaluation assesses the changes in well-being that can be attributed to a particular policy or program. The impact of a program or policy is the amount of change in any outcome (short, medium or long-term) which is caused by a program or policy (Legovini 2006). The impact of the program is thus the difference between the outcome with the program and the outcome without the program. Thus evaluation research is undertaken for the purpose of determining the impact of some social intervention, such as a program aimed at solving a social problem (Babbie 2003). In its simplest sense, evaluation research is the process of determining whether a social intervention has produced the intended results. Similarly, Kumar explains impact evaluation as the most widely practiced type of evaluation which is used to assess what changes can be attributable to the introduction of a particular intervention, program or policy (Kumar 2005).

Impact evaluation performs several main functions in policy analysis. First, and most important, evaluation provides reliable and valid information about policy performance, that is, the extents to which needs, values, and opportunities have been realized through public action. In this respect, evaluation reveals the extent to which particular goals and objective have been attained (Dunn 2004). Thus, impact evaluations help identify the causal link between outputs and outcome and are required to inform policymakers and the public on which public actions have been effective and which ones have not worked so well in reducing food insecurity and poverty.

Evaluations are used in a large number of fields and to answer a very wide range of questions about when and how interventions work. There are numerous approaches that can be used, and the decisions about which evaluation model or models to adopt will depend crucially on the questions of interest and the nature of the policy or program to be evaluated. At the very basic level, in designing an evaluation the key questions that need to be considered are:

- Do we need to know how the policy or program operates on the ground? Process evaluation addresses these questions. Almost all large scale evaluations of government policy will include some elements of process evaluation since this is the side of the evaluation that provides most information on how the policy should be managed or developed in the future. Process evaluation verifies what the program is and whether or not it is delivered as intended to the targeted recipients.
- Do we need to know what impact the policy or program has in terms of desired outcomes? Do we need to know what would happen, should it not be in place? Impact evaluation addresses these types of questions. The primary aim of an impact evaluation is to measure whether a particular program has achieved its desired outcomes. To do this, outcomes with the program in place are measured and compare them to outcomes without the program (i.e. the counterfactual).

Sometimes, evaluations may only need focus on either the process or the impact of the policy or program. More commonly, researches involve both elements and thus both types of evaluation. There are various ways developed to measure the impact of a policy or program has on a relevant outcome or outcomes. In most instances, it is extremely difficult to make an accurate estimate of the program's impact (Purdon, Lessof et al. 2001). To do this, it should be measured what would happen to the relevant outcome or outcomes if the program were not in place. This is called, measuring the counterfactual. The counterfactual should only be estimated when the primary outcomes for a policy or program are expressed in terms of change. For instance a policy objective might be written in terms of increasing rural households (the poor) access to food, increasing food availability or reducing the numbers on food insecure population/drought affected population. In these instances the counterfactual is the figure from which the increase or reduction is achieved.

#### **2.4.1. Types of Evaluation Research Designs**

Three main types of research designs are appropriate for evaluations: experimental designs, quasi-experimental designs and qualitative designs (Babbie 2003). Experimental designs or the randomized trail is considered as the 'gold standard' for evaluation. However, it is not always used in practice. This is because of practical difficulties in implementation. All other designs are referred to as 'quasi-experimental' which includes the matched area comparison design, the before-after designs, and the matched comparison group design (Purdon, Lessof et al. 2001). For the purpose of this evaluation research quasi-experimental particularly the before - and - after (time-series) designs is employed to analyze the impact of governmental intervention. The merits and demerits of this design are discussed below.

##### **Before – and – after design**

Before – and - after designs or time series designs is incorporated into most evaluation designs. A before-and-after design is a research design that involves measurements made over some period. In a standard before-after study, outcomes will be measured for a program both before the program is implemented and after. The difference between the before and after measurements is taken to be the impact of the policy. In this instance, the 'before' – or 'baseline' – measurements act as the control measurements. Before-after studies are primarily used in instances where a policy is implemented nationally (Purdon, Lessof et al. 2001). Moreover, the before-and-after design is technically sound and appropriate for measuring the impact of an intervention (Kumar 2005).

The key strength of the before-after design is that it is possible, to implement a policy nationally and yet still obtain a measure of the impact that policy has. The main weakness of the design is that change brought about by the policy cannot be separated out from change that would have happened anyway (i.e. 'natural change' or change brought about the introduction of other policies at about the same

time). This is particularly problematic if the expected change due to the policy is smaller than the change that happens ‘naturally’ from year to year. But the design can be strengthened quite considerably if the time series is extended to several years or periods before the implementation of the policy and several years after the policy is implemented. It then becomes possible to look for an ‘interruption’ or ‘shift’ in the time series at the time the policy is introduced and to check that the shift is sustained over time. However, although this is a relatively powerful approach, the strong data requirements mean that it is usually only possible to use administrative data or other standard datasets such as large repeated government surveys.

The rationale for food security evaluation systems is to provide information about developments in food security which can form the basis for government policy interventions and program design. Policy level indicators for attaining the long-term food security objective can generically be defined as: food availability, efficiency of the food marketing system, income level and distribution, employment opportunities, stability of food supplies, changes in coping capacity/resilience, level of food consumption, food utilization and improved diet composition/nutritional status.

Monitoring the impact of policy change on food security requires longer-term measurement of higher level indicators. Selection of policy indicators can be country specific relating to national goals and sectoral objectives. In the context of the scaling up of the special program for food security it is vital to assess achievements and trace the impacts on the household food security situation of the interventions launched through the program. Thus, impacts of food security policies is assessed by looking at its impact on a variety of different aspects of food security using the food security core indicators outlined in Figure 5 below.

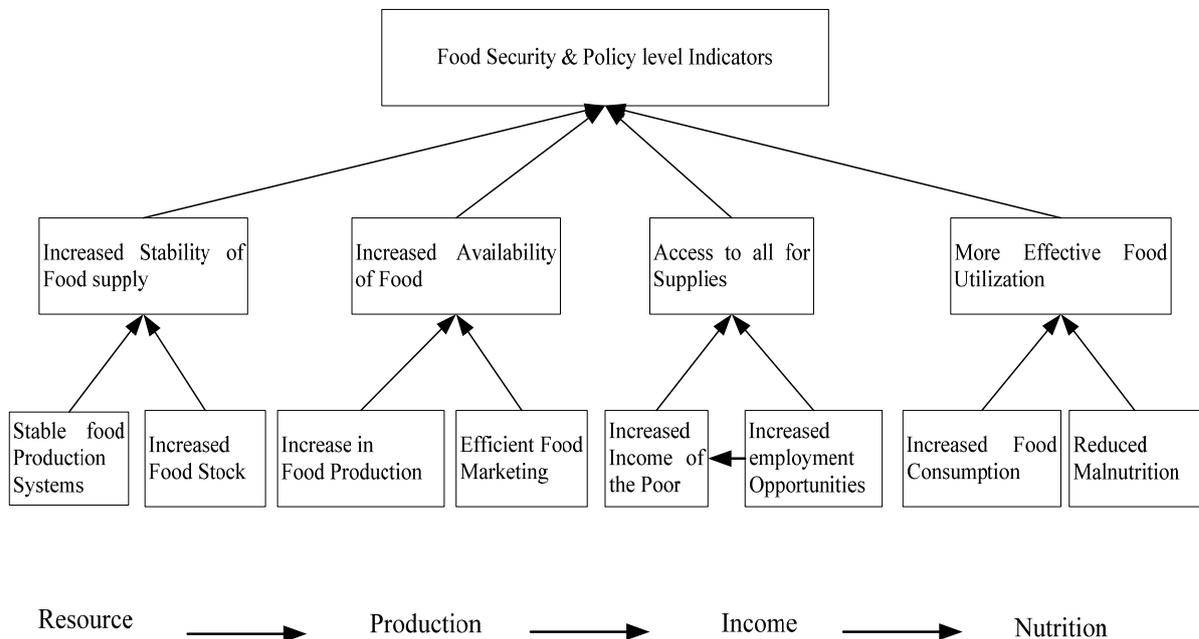


Figure 5 The interrelation of generic indicators of food security, adopted from Metz, M 2002

## **3. Research Methodology**

### **3.1. The Research Techniques**

The advantage of employing qualitative and quantitative methods in research is getting increasing recognition among researchers. It enables to benefit from the insights that the two methods provide when used in combination. Moreover, the most effective evaluation research is one that combines qualitative and quantitative components (Babbie 2003). Thus, the research strategies employed in this study combine both qualitative and quantitative methods. Qualitative method is used to capture data pertaining local perception and opinions on the effectiveness of policy intervention and policy outcomes using semi-structured questionnaire. Quantitative data on households asset ownership, income status, food security status, demographic characteristics and other basic information was collected from sample households using structured questionnaire where my data collector interview each sample household head following the standard administration of interview procedure in this method.

### **3.2. Selection of Study Area**

The study site constitutes two drought prone districts of Tigray region. The two districts are randomly drawn out of the food insecure districts of Southern and Eastern zones which are identified by the regional state. Sample tabias were selected adopting a stratified sampling approach based on food security situation and irrigation projects. Thus three tabias were selected from each district so as to include a systematic variation in agro-climatic conditions and agricultural potential.

Fifteen sample households from each tabia, totalling 90 from the two districts, were randomly selected in collaboration with the respective development agents. In order to randomly select the 90 sample households, list of household heads (which is the sampling frame from which a probability sample is selected) by tabia were supplied by respective tabia administrations. These lists were each used to select 15 households from each tabia by employing simple random sampling technique. This method of sample selection has given every household heads in each tabia a chance of being included in the sample. Therefore the sample selection is free from bias. In a nutshell random sampling approach is employed to select the study areas and sample respondents in which the subjects selected are supposed to meet the study needs.

### **3.3. Data Source and Acquisition Methods**

The study is based on both primary and secondary sources of information. Primary data was collected through survey, focus group discussions, and field observations. Secondary data were collected from governmental organizations both at regional and district level. The sources and methods used to acquire data for the research are outlined below.

#### **3.3.1. Primary data**

Most of the data required to answer and validate the research questions were collected from primary sources. To generate the required data from the primary sources, different methodological approaches such as in-depth interviews, focus group discussions, and field observations were employed. These techniques were used to collect data pertaining household demographic characteristics, main livelihoods, asset ownership, income, crop production, household coping strategies, farm input use, food security status of households, opinions and understandings of households as to how the government policy intervention has addressed to the problem.

### **Training of interviewer and testing questionnaire**

In order to minimize the errors in data collection that may be introduced by the enumerator, training was provided to ensure that the questionnaire was understood by the enumerator, and was asked correctly and consistently. Moreover, pilot survey was conducted in order to test the contents of the questionnaire by taking a sample of target population from a tabia nearby the city of Mekelle called Aynalem. This served as a demonstration to check the interviewers' understanding of the study, and how it is administered. In addition to this the pilot survey was intended to test whether additional questions needed, respondents understanding of the questions and check for omission of questions. After the pilot survey, the questionnaire was revised and things that were unclear were discussed. (A copy of the household questionnaire is attached as Appendix B).

### **Interview**

Interviews with the selected 90 sample household heads, 15 household from each tabia, were conducted and the necessary information was obtained. It includes information about household food security status, about their coping strategies, income, access to productive technologies, and how governmental responses and interventions have been effective and changed their quality of life had been obtained.



Figure 6 Photo showing interview session

### **Focus Group Discussion**

Focus group discussion provides an appropriate area to bring together program beneficiaries to share their experience of the policy interventions. Focus group discussions with target groups were held in each district to enrich the first hand data collected through interview. Discussion with regional and district level concerned officials, such as Agriculture and Rural Development, Food Security Coordination Office, Finance and Economic Development both at the regional and district level including with some experts was also held. Besides group and individual discussions was also carried with the target beneficiaries' and with key informants from local non-governmental organizations.

### **Observation**

Observations of the people's way of life, their assets and resources, the ups and downs to overcome their daily struggles, their activities for living, etc, would provide valuable and supportive information. Having a good look at the physical and socio-economic infrastructures, the different economic activities people are involved with and government intervention programs currently undertaken would provide valuable contributions to understand the existing real situations and the overall situation of the poor. Thus, in this study an attempt was made to carefully observe every situation and understand them fully. Besides, direct field observation was employed as one of the methods to look how the policy programs are integrated with environmental sustainability.

### 3.3.2. Secondary Data

Secondary data was collected to analyze the impacts of government intervention on the food security policy level indicators both at regional and district level. The secondary sources of information included government annual reports, official statistical abstracts, and researches undertaken in the area. A visit was made to Tigray Region Food Security Coordination Office, Bureau of Agricultural and Rural Development, Ethiopian Roads Authority, Tigray Region Bureau of Finance and Economic Development, Disaster Prevention and Preparedness Commission and Agricultural Marketing Promotion agency both at the regional and district levels to collect the necessary secondary information for the study. Moreover, the data published in different books, policy documents about agricultural development and food security and research journals were also important to accomplish the research. The data collected during the field work are shown in **Table 1** below.

Table 1 Secondary data collected

SN	DATA TYPE	YEAR
	<b>Region level</b>	
1	Core food security indicators for Tigray Region	2000-2005
2	Contribution of agriculture to total GDP	1997-2006
3	Changes in population, cultivated land and Agricultural production in Tigray	1997-2006
4	Drought/disaster affected population in Tigray	1997-2006
5	Food Aid distributed in Tigray	1997-2006
6	Total land area cultivated	2000-2006
7	Demographic data	
8	Amount of credit disbursed	2000-2005
9	Agricultural inputs distributed	2000-2006
10	Rural road network and Road network density	
11	Mean annual Rainfall and GDP Growth in Tigray	1997-2006
	<b>District Level</b>	
1	Socio-economic data for 34 rural districts	
2	Drought disaster affected Population for 34 rural districts	2000-2005
3	Total area cultivated and crop Production by district	1998-2006
4	Profile of education by district	1999-2006
5	Pre-harvest crop assessment and food security situation	2000-2005
6	Population resettlement	2003-2005
	<b>Map</b>	
1	Land use/Land cover	
2	Land, water and climate resources of the region	
3	Social service infrastructure distribution in the region	

### 3.4. Data Preparation

The collected data was entered immediately after field survey and this was done simultaneously with the field survey during the period. Data was checked for mistakes and entered in SPSS data sheet. Besides, the secondary data collected from different sources was in a hard copy format and these were converted to appropriate data format for analysis.

### 3.5. Methods of Data Analysis

Analysis of data provides sense for the data collected during the field work. The research strategies employed in this study combine both qualitative and quantitative methods. The advantage of simultaneously employing qualitative and quantitative methods in the study of rural livelihoods is getting increasing recognition among researchers. This is because it enables to benefit from the insights that the two methods provided when used in combination. In summary the methodological framework employed for the data analysis is outlined in Figure 7 below.

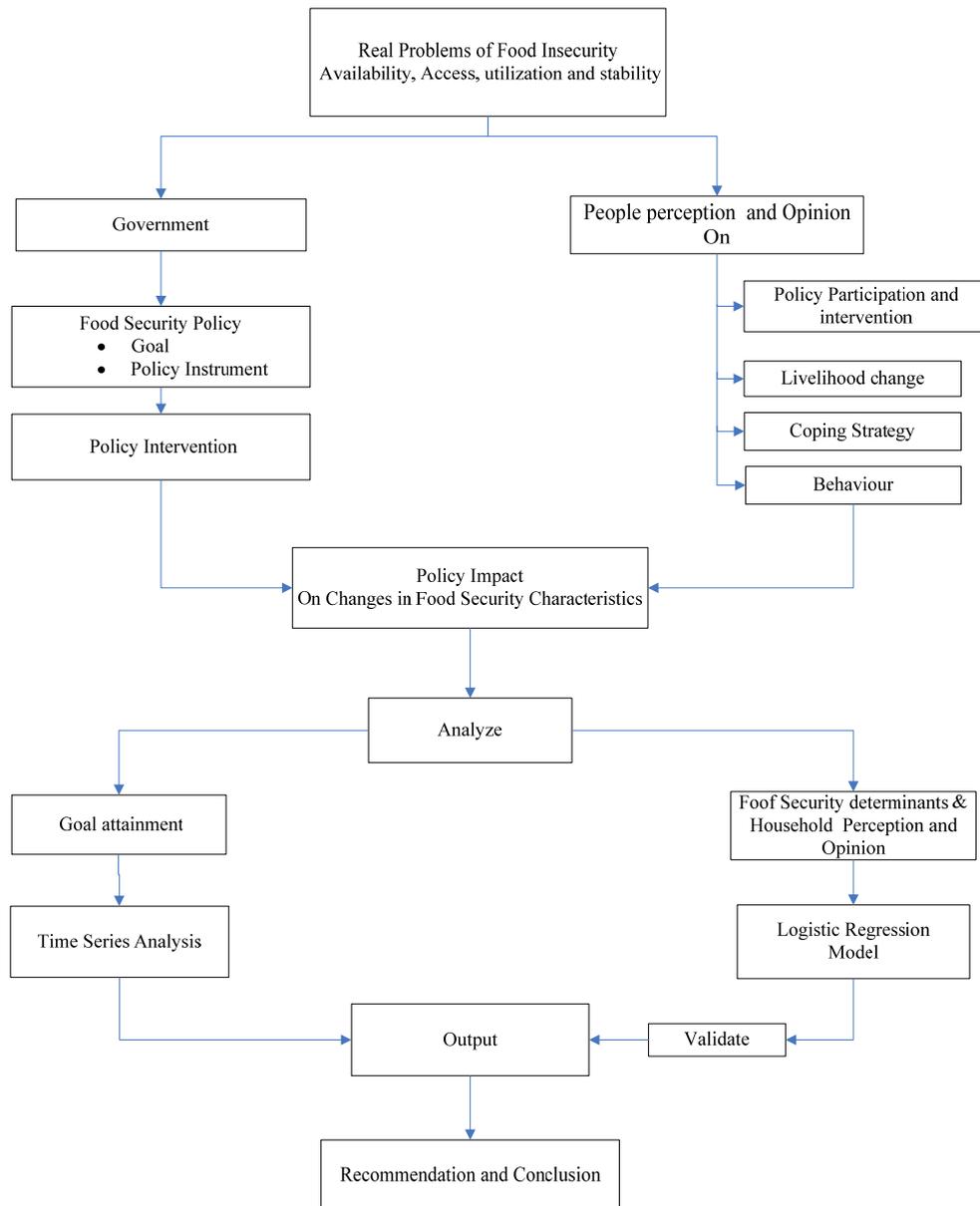


Figure 7 Methodological Framework

#### 3.5.1. Qualitative analysis

Qualitative data gathered from key informants and the review of documents was compiled, organized, summarized and interpreted on the basis of food security strategies and programs, regional policies as well as the implementation of the programs and their outcomes.

### 3.5.2. Quantitative analysis

The primary data collected from survey was analyzed by employing statistical tools. Two methodological approaches were used to analyze the data collected. Those are Logistic regression analysis and spatial analysis. The details of each methodological approach employed are outlined below.

#### 3.5.2.1. Specification of the model

Choosing an appropriate model and analytical technique depends on the type of variable under investigation. Methods and regression models deal with cases where the dependent variable of interest is a continuous variable which we assume, perhaps after an appropriate transformation, to be normally distributed. But in many applications, the dependent variable of interest is not on a continuous scale; it may have only two possible outcomes and therefore can be represented by an indicator variable taking on values 0 and 1.

In this study, the dependent variable Y (current food security status of households) was defined to have two possible outcomes: (1) the households are food secured and (2) the households are not food secured. These two outcomes are coded 1 and 0 respectively. This shows that the dependent variable is dichotomous and it can be represented by a variable taking the value 1 with probability  $\pi$  and the value 0 with probability  $1 - \pi$ . Such a variable is a point binomial variable, that is, a binomial variable with  $n = 1$  trial, and the model often used to express the probability  $\pi$  as a function of potential independent variables under investigation is the logistic regression model. Therefore, to sort out which explanatory variables are most closely related to the dependent variable, 12 factors are considered. This method involves a linear combination of the explanatory or independent variables. Thus, the study is modelled within the framework of above mentioned theories and the model used by this study to determine factors affecting current food security status is given below.

$$\pi_i = \frac{1}{1 + \exp\left[-(\beta_0 + \sum_{j=1}^k \beta_j \chi_{ji})\right]} \quad \text{where } i = 1, 2, \dots, 90 \quad \text{Equation 1}$$

Or equivalently

$$\ln \frac{\pi_i}{1 - \pi_i} = \beta_0 + \sum_{j=1}^k \beta_j X_{ji}, \quad \text{where } k = 12 \quad \text{Equation 2}$$

Where:  $\pi_i$  stands for the probability of household  $i$  being currently food secure,  $y_i$  is the observed food security status of household  $i$ ,  $\chi_{ij}$  are factors determining the food security status for household  $i$ , and  $\beta_j$  stands for parameters to be estimated.

Rearranging the equation, with the dependent variable (food security status) in log odds, the logistic regression can be manipulated to calculate conditional probabilities as

$$L = \prod_{i=1}^n \frac{\left[ \exp(\beta_0 + \sum_{i=1}^n \beta_j \chi_{ji}) \right]^{y_i}}{1 + \exp(\beta_0 + \sum_{j=1}^k \beta_j \chi_{ji})} \quad y_i = 0, 1 \quad \text{Equation 3}$$

Once the conditional probabilities have been calculated for each sample household, the “partial” effects of the continuous individual variables on household current food security can be calculated by the expression

$$\frac{\partial \pi_i}{\partial \chi_{ij}} = \pi_i(1 - \pi_i)\beta_j \quad \text{Equation 4}$$

The “partial” effects of the discrete variables are calculated by taking the difference of the probabilities estimated when value of the variable is set to 1 and 0 ( $\chi_i = 0$ ,  $\chi_i = 1$ ) respectively.

### Testing Hypotheses in Multiple Logistic Regression

Once a multiple logistic regression model is fitted and estimates for the various parameters of interest are obtained, answers to questions about the contributions of various factors to the prediction of the binary response variable food security status are obtained. To test such questions overall regression test will be employed in this research. Overall test is a regression test applied to test whether the entire set of explanatory variables contribute significantly to the prediction of response. Thus, the overall regression test for a model containing k factors, say, is given by

$$\pi_i = \frac{1}{1 + \exp\left[-(\beta_0 + \sum_{j=1}^k \beta_j \chi_{ji})\right]} \quad i = 1, 2, \dots, 90 \quad \text{Equation 5}$$

The null hypothesis for this test is stated as: “all k independent variables considered together do not explain the variation in the responses.” In other words,

$$H_0 : \beta_1 = \beta_2 = \dots = \beta_k = 0$$

To test the null hypothesis likelihood ratio test and score test statistics can be used; each has a chi-square distribution with k degrees of freedom under  $H_0$ . The test statistic for likelihood ratio employed in this research is given below.

- Likelihood ratio test:

$$\chi_{LR}^2 = 2 \left[ \ln L(\hat{\beta}) - \ln L(0) \right] \quad \text{Equation 6}$$

The dependent variable, current food security status of households, was measured as follows. Households who are able to year round access to the amount of food required by all household members were regarded as food secure and were assigned a value of 1, while households experiencing a food deficit were regarded as food insecure and these were assigned a value of 0. Twelve explanatory variables were identified to be major determinants of current food security status in this study. These include income status now, policy intervention, leadership, farm size, input use, participating in irrigation projects, type of household head, off-farm activities, education and program participation. Based on the above theoretical framework different test of hypothesis will be carried out in this study. A test of association between different variables such as test of association between policy intervention and food security status, test of association between current food security status of households and engaging in off-farm activities, food security status and household’s participation in irrigation projects, e.t.c., is done using a  $\chi^2$  (Chi-square) test.

Furthermore, to analyze spatial patterns in food insecurity and determine the factors that contribute to the spatial similarity or dissimilarity in space, test of spatial auto regression was used. The most common ones are simultaneous auto-regression (SAR) and conditional auto-regression (CAR), of which the latter is theoretically more satisfactory (Cressie 1993). CAR model is a spatial autoregressive model with basic notation:

$$Y = \rho W_y + X\beta + \varepsilon \quad \text{Equation 7}$$

Where

- Y = dependent variable
- X = explanatory variables
- $\beta$  = regression coefficient
- $\varepsilon$  = random error term
- $\rho$  = spatial autoregressive coefficient and
- $W_y$  = spatially lagged dependent variable.

The model is applied to measure the level of spatial dependency and to see the effect of different groups of variables. Testing for spatial clustering will also help to identify spatial similarities or dissimilarity of food insecurity (poverty) in neighbouring districts. This will help to locate similar and dissimilar neighbourhoods and their influence on the incidence of food insecurity and poverty; and it also helps to identify the factors that contribute to spatial similarities or dissimilarity.

### 3.6. Reliability and Validity of the Research outcome

Validity is the degree to which a study actually measures or reflects what it intends to measure while reliability refers to the consistency and conformability of a research finding. In this kind of research one of the difficult tasks is achieving valid and reliable results. Because given research cannot be carried out without problems. There were some factors in this study that can affect its validity and reliability. One of the problems was wrong perception of respondents. Some of the respondents were suspicious of the study, associating it with food aid as some of the study issues are related with the food adequacy status of households. The other problem was securing data that are aggregated at district level have been limited and securing time series data from government agencies have been limited due to lack of data base systems. Besides, available reports at both regional and district level are not well documented.

However, in spite of the above mentioned problems the following precaution measures were taken in order to maintain and ensure the reliability and validity of the outcome of this research. These are:

- Focus groups both at regional and district level was used to obtain opinions on issues related to food security policy effectiveness. Also questions were included in the questionnaire to pin down individual respondent's perception and opinions on the policy intervention.
- Study areas and sample households were drawn using scientifically valid sampling approaches and this would make the research free from bias.
- The insights obtained from both the combined use of qualitative and quantitative methods simultaneously increase the strength of the conclusion.
- The fact that the methods and procedures applied in collection and analysis are clearly outlined enables the replication of the study.



Southern and Eastern zones, where it is bimodal. The study areas (Kilte Awelaelo and Hintalo Wajerat districts) are located in areas with low annual average rainfall.

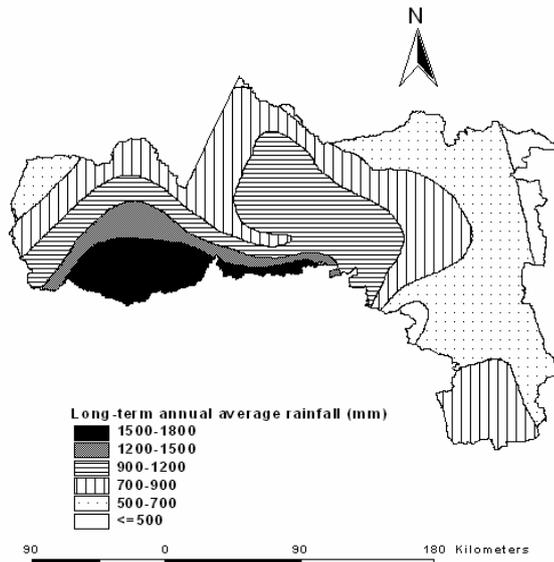


Figure 9 Spatial distribution of average annual rainfall in Tigray (WBISPPO, 2002)

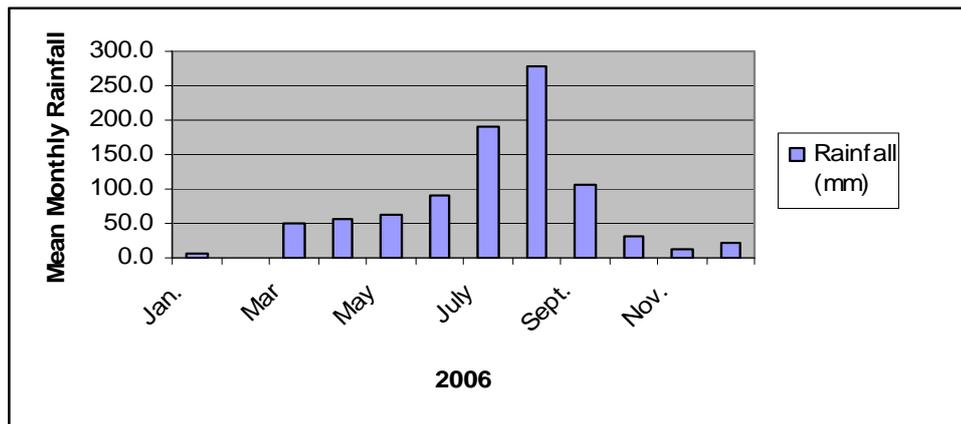


Figure 10 Mean monthly rainfalls for Tigray, 2006

The region has a diverse topography, with peak highlands (8%), midlands (39%) and lowlands (53%), which together create diversified agro ecological conditions. The wide range of variation in altitude (2000-4000m above sea level) governs the temperature range and climatic conditions in the region. On the basis of altitude six major agro-ecological zones are identified: Upper Dega, Dega, Weyena Dega, Upper Kolla, Lower Kolla and Wurch (BOFED 2007).

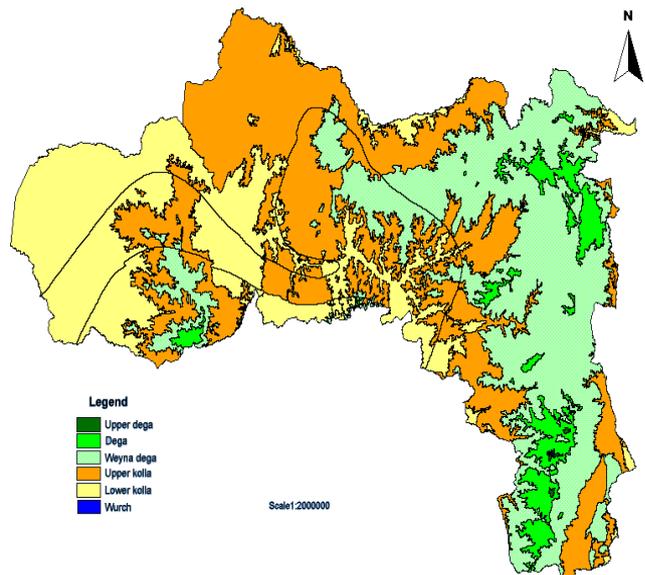


Figure 11 Agro-ecological zone based on altitude, BOFED 2002

#### 4.4. Land Use Pattern

The distribution of land use/land cover type in Tigray is given in **Table 2**. The major types of land use are bush and shrub land (36.2%), cultivated land (28.2%), and grass lands (22.8%). Other forms of land use account for 10.81% of the land mass (BOFED 2007). Cultivable land is the dominant land use in the highlands of Tigray where there is high population density. The natural forest resource of the region is overexploited and covers only about 0.2% of the total land area. The decline in forest cover is closely linked with human economic activities and population pressure.

Table 2 Land use/land cover type of Tigray region

LAND USE-LAND COVER TYPE	AREA (HECTARES)	PROPORTION (%)
Cultivated land	1,434,792	28.21
Grassland	1,158,681	22.78
Bush land and shrub land	1,840,918	36.20
Woodland	295,082	5.80
Natural forest	9,407	0.20
Afro alpine	670	0.10
Exposed rocks and soil	335,569	6.60
Water body	8,053	0.16
Urban	2,610	0.05

(Source: BOFED, 2002)

#### 4.5. Demography

The 1994 Population Census results puts the total population of Tigray region at over 4.5 million of which 85 percent live in rural areas, with an average family size of five people per household. Population growth in Ethiopia is high; in the Tigray region the population is growing at 2.7% per year (BOFED 2004). There is an estimated 729,366 rural households, of which 73.5% are male-headed and 26.5% are female-headed (CSA 2007). The population density in the region is 88.8 persons per square kilometre (CSA 2007). Of course, there exists a considerable disparity among its districts it ranges from 11.9 in Kafeta Humera to 350.7 in Ganta Afeshum. The average arable land holding in the region is 0.90ha per household varying from 0.5 ha in the highlands to 2.0 hectares in the lowlands.

#### 4.6. Socio-economic aspects

##### The Economy

Agriculture in Tigray is the dominant source of subsistence for the majority of the population. It accounts for about 52.9 percent of GDP and 85 percent of employment. Over 90 percent of the crop output is produced by the peasant sector, which is characterized by a low-level of technology and largely rain-fed.

There has been an improvement in agricultural growth since 1992, especially compared to its level in 1980s. However, its overall impact in lifting the economy is not significant due to increases in population pressure and recurrent droughts that disrupt progress. For instance, in 2000 GDP growth declined to -0.45 % from the record 15.4% growth in 1997. Severe recurrent drought is one reason for such fluctuations in the performance of the economy, which is largely dependent on agriculture.

## 4.7. District Profile

### 4.7.1. Hentalo Wajerat District

#### Location

Hentalo Wajerat district is one of the 8 districts of the Southern Zone of Tigray Region and is one of the drought prone and chronic food deficient districts in Tigray. It is bounded by Raya-Azebo in the South, Samere-sehareti and Alaje districts in the West, Afrar Regional State in the East, and Mekelle town in the North. Geographically the district is situated at 12<sup>o</sup>54'00" and 12<sup>o</sup>22'00" North of Latitude and at 39<sup>o</sup>17'30" and 39<sup>o</sup>46'00" East of Longitude. It covers a total land area of 1933.09 square kilometres.



Figure 12 Map showing surveyed Tabia's in Hentalo Wajerat district

**Demography:** The total population of the district was estimated at 154,187 of these 75,699 (49.1%) are male and 78,488 (50.9%) are female in the year 2007 (CSA 2007). Out of the total population about 90.46% of the population is living in rural areas and 9.54% is living in urban areas. Average family size is five and population density of the district is 87.4 people per square kilometre.

#### Agro-Ecology

The altitude of the district ranges from below 1400 meter above sea level to 2700 meters above sea level. Agro-ecologically the district is characterized as Arid zone comprising three agro-ecological zones; Kolla (< 1500 masl), Weina-Degua (1500 – 2300 masl), and Degua (> 2300) that constitutes 13.75%, 63.75%, and 22.5% of the total area coverage of the district respectively.

**Climate:** Rainfall in the district is characterized by one rainy season. The area is known by having uni-modal rainfall pattern that covers from June to September. Small area (16 %) of the district has bimodal rainfall pattern. The average annual rainfall generally varies between 435.26 mm-674.08 mm and the average minimum and maximum temperature is 15<sup>o</sup>c and 30<sup>o</sup>c respectively.

**Topography:** Land escape formation of the district is mountainous, undulating, flat and plain lands, rugged valley and gorges, and hilly areas. As a result of continuous land exploitation by manmade and natural calamities, the land is severely eroded and the soils are low in their fertility.

**Land Use:** The district has a total area of 193,309 hectares, of which 40.22 % (77,749 ha) are cultivated land, 2.01 % (3,885.5 ha) are forest land, and 57.77 % (111,674.5 ha) are uncultivated, grazing land, non-utilized land and other uses. The average land holding size per household is 0.75 hectare.

**Economic Activity:** More than 80 percent of the population living in the district is engaged in subsistence farming with some animal husbandry. Agriculture is the most dominant source of food and/or income to lead their livelihoods in the district. They produce more staple food crops directly related with consumption and less with cash crops or fruits for sale.

#### 4.7.2. Kilte Awelaelo District

##### Location

Kilte Awelaelo district is one of the 7 districts of the Eastern Zone of Tigray Region. It is one of the drought prone and chronic food deficient districts in the region where 61% of the population are food insecure (TFSCO 2003). Geographically the district is situated at 13°48'57" and 14°18'38" North of Latitude and at 4°48'15" and 5°10'25" East of Longitude. It covers a total land area of 987.83 square kilometres.

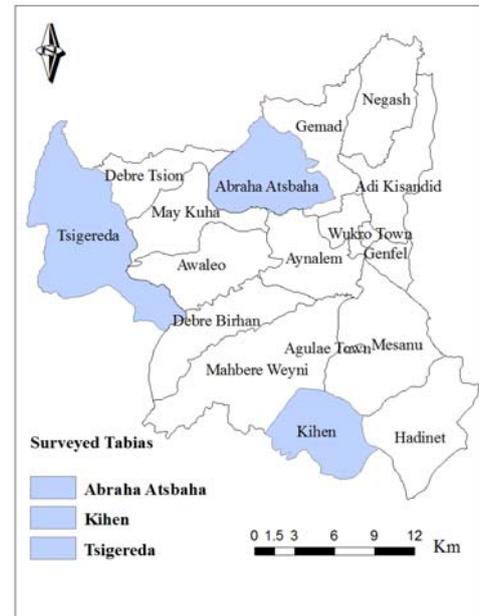


Figure 13 Map showing surveyed Tabia's in Kilte Awelaelo district

**Demography:** The total population of the district is estimated at 154,187 of these 75, 699 (49.1%) are male and 78,488 (50.9%) are female in the year 2007 (CSA 2007). Out of the total population about 90.46% of the population is living in rural areas and 9.54% is living in urban areas. Average family size is five and population density of the district is 87.4 people per square kilometre.

**Agro-Ecology:** The district consists mid-land plateau ranging in elevation from 1900 meter above sea level (masl) to 2200 meters above sea level with chained mountains as high as 2500 masl at the peak. Agro-ecologically, it is classified as mid-land (Woinadegua). The woreda has three agro-climatic zones locally known as Degua (16%), Hawsi-Degua (81%) and Kolla (3%) which means highland, middle highland and low land respectively. The average rainfall varies from 300 – 550 mm. The main rainy months mainly ranges from June to August. However, rainfall is highly erratic thus unpredictable in distribution, intensity, onset and succession. The district has cool and warm climate with temperature ranging from 15<sup>0</sup>c - 20<sup>0</sup>c.

**Land Use:** The total land area of the district is 97,000 hectares, of which 40.22 % (77,749 ha) are cultivated land, 2.01 % (3,885.5 ha) are forest land, and 57.77 % (111,674.5 ha) are uncultivated, grazing land, non-utilized land and other uses. The average land holding size per household is 0.75 hectare.

#### 4.8. Conclusion

The above short description gives an overview of the physical, demographic, and socio- economic situation of the Tigray region in general and the study district in particular. The region has different agro-ecological zones, and abundant water resources which are important resource bases for increasing agricultural production. The different agro-ecological zones have potentials for growing a variety of crops. The abundant water resource is a huge potential for irrigation development.

Although the region seems to have high potential for agricultural growth, its infrastructural and socio-economic development is very low. The low level of socio-economic development and limited infrastructure is far worse in some remote district. Social services like health, education, and water, etc are showing gradual improvement. However, basic marketing infrastructures are still lacking behind. Therefore, it is important to develop these facilities in addressing any development program including food security. The proper management and utilization of the available natural resources potential is also indispensable to enhance agricultural productivity and achieve food security.

## 5. Causes for Household Food Insecurity in Tigray

### 5.1. Food Security Situation in Ethiopia

The incidence of poverty in Ethiopia is high, with about 45% of the rural population and 37% of the urban population living below the nationally defined poverty line (MoFED 2002). Food availability in Ethiopia is mainly determined by the country's domestic production. However, domestic production has failed to meet the food requirement of the people. The country has been food deficient since the 1960s. Food insecurity among the population is wide spread, most devastatingly; there have been some instances of famine that cost the lives of about a million people. Food production has been insufficient to feed the people, and consequently, food security has been non-existent for about 52 percent of the country's population. Food security situation in Ethiopia is highly linked up to severe, recurring food shortage and famine, which are associated to recurrent drought. Currently there is a growing consensus that food insecurity and poverty problems are closely related in the Ethiopian context. While efforts to ensure adequate food supplies at the national level are laudable, these efforts on their own cannot ensure food availability for households and individuals.

### 5.2. Regional Situation

Poverty is extremely high in the region and recent reports show nearly 75% of the population is living below the absolute poverty line (BOFED 2004). According to BOFED (2004), the average household level production in the region (which is 6.59 quintal) covers about 38% of the annual food demand of the average household. Only about 17% of households are self-sufficient.

Tigray is one of the regions in Ethiopia worst affected by recurrent drought and food insecurity and has suffered from food deficit for many decades. The average annual crop production in the region is 12,811,000 Quintals, showing 6,087,326 Quintals deficit to meet the annual regional food demand. This is more severe in drought prone districts with annual deficit of 73 percent. This implies that these drought prone districts are producing only 27 percent of their annual food demand (TFSCO 2003). Drought is the most catastrophic natural event affecting food security and widespread periodic famine in the region.

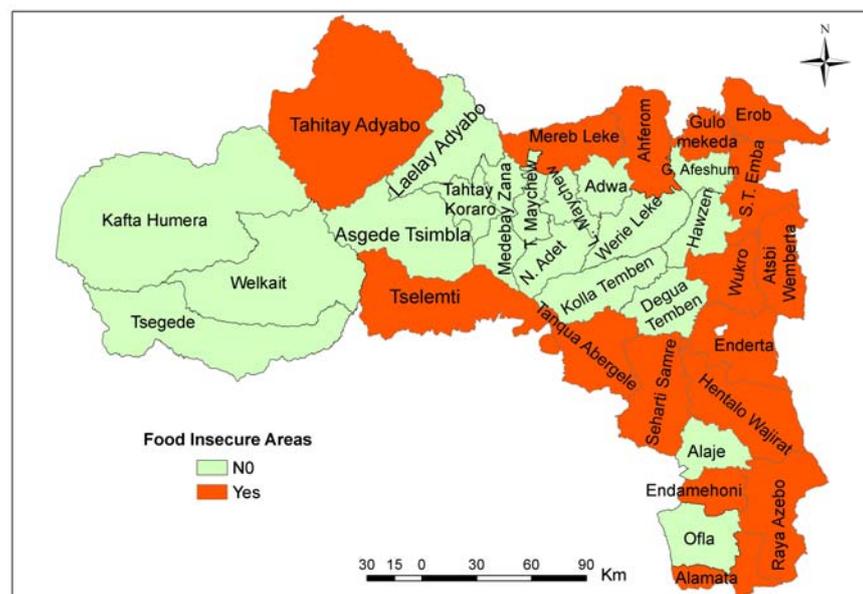


Figure 14 Map of Food Insecure districts in Tigray

The drought condition has extended over several seasons and has caused extreme stress on coping mechanisms and the general health status of the people. Particularly the 16 districts which are shown in Figure 14 above are prone to drought where majority of the people can not feed themselves and have thus to depend on food aid for their survival. A study conducted by Bureau of Agriculture and Rural Development revealed that the average annual crop production in the 16 drought prone districts covers only 27 percent of their annual food demand of the 350,000 households living in these districts (TFSCO 2003). Income from non-farm support options is very low. Agricultural production and income from off-farm sources covers less than 60 percent of the annual demand of a household with an average family size of five. According to the 2004 Welfare Monitoring Survey, 31.9 percent of the households faced food shortage which is almost the national average of 31.1 percent. Available literature about the food security situation of the region in general indicates that quite a large proportion of the region's population is unable to produce adequate food for the whole year. (*Mekelle, the capital city of the region, which is shown by white colour in Figure 14 above is not included in any of the analysis carried out in this research*).

### **5.3. The Underlying Causes for Household Food Insecurity**

The root causes for food insecurity at the regional and household level is quite complex. It is a combination of both natural factors and manmade processes. The underlying factors in general can be grouped under three main types as natural causes, socio-economic factors, and policy failures.

#### **5.3.1. Natural Causes**

Drought and environmental degradation are important natural factors that make households vulnerable to food shortage. The pattern of rainfall in the drought prone districts is inadequate for rain fed agriculture. Rain starts late after the normal planting season has already gone and stops early when the cultivated crops are at their vegetative stages of growth. Therefore, there is a clear moisture stress in the drought prone districts with its adverse impact on farming practice.

Besides, natural resource degradation is serious problem in the study area. Natural resources like soil and forests are vital resource bases upon which rural farmers depends for their survival. However, these resources are getting depleted over time at an alarming rate and affects farmers' agricultural production and productivity. In general, the ecology in the area has become more fragile than ever resulting in a decline in agricultural production and productivity, frequent food shortage, drought and famines.

#### **5.3.2. Socio-economic Factors**

Social factors such as population pressure, traditional farming system and practices, and economic limitations like poor infrastructural services, shortage of farm land and other productive assets are also factors responsible for the households' food insecurity in the region. One of the main socio-economic problems in the region is population pressure. Many scholars attributed the cause for the food self insufficiency to the high rate of population growth. In the region the rapid population growth coupled with a stagnation of agricultural technology over the past two decades makes it difficult for agricultural production to keep pace with the rising demand for food. The demographic pressure is putting pressure on the existing amenities. Rural population growth raises issues about the slow pace of rural-urban transition in the region and the consequent lack of dynamism in non-farm sub-sectors in rural areas.

Poor infrastructural services are the main constraint to food security. Infrastructural services such as marketing, rural transport communications are essential to achieve household food security in particular or for poverty alleviation in general. However, there are marketing problems, and lack of transport communication in the study area.

Traditional practices are also contributing negatively to the efforts made in addressing the problems of food insecurity. Despite there are good and beneficial traditional practices there are traditional values that do not encourage innovations and innovative that have significant impact on households' food security. Celebrating many days in a month as "non-working religious days" and big memorial feasts are among others, the prominent traditional practices among rural households.

Shortage of farmland and other productive assets is also the most important limiting factor for farmers in the region. For rural farmers food availability is highly determined by their own agricultural production and available assets mainly livestock. Therefore, landholding size is crucial for farmers' food security situation or for their livelihood security in general. Data from Bureau of Finance and Economic Development shows that the per capita arable landholding size in the region is diminishing from 0.31ha in 1997 to 0.19ha in 2006 mainly due to increasing population size and inability of the non-farm sector to provide employment. This per capita land holding is by far below the minimum area required to produce for households with the current average productivity of cereals.

In general a combination of short-term and long-term causal factors can explain the trends towards the increasing food insecure caseload. Long-term factors, such as the interaction between environment, high population growth, and diminishing land-holdings led to significant decline in productivity per household. These trends have combined the repeated effects of drought over the years, to substantially erode the productive assets of communities and households.

### **5.3.3. Government Policy Failures**

Inappropriate governmental policies and institutional weakness are main responsible factors for the recurrence of food shortage or poverty and underdevelopment in general. Whenever food shortage or famine occur in a given country, the government is responsible for either causing the crisis or failing to prevent it. In Ethiopian circumstances lack of appropriate development policies and strategies is one of the main factors which results vulnerability to disaster.

During the pre 1974-feudal and Dergue 1974-1991 regimes, policies and strategies to promote agricultural production and food security were limited or non-existent. The country has suffered from misguided economic policies under the socialist Dergue regime, which ruled from 1974 until 1991. The official policies that have implemented during the Dergue regime (1974-1991) deliberately marginalize the people on the basis of race and ethnicity. Tigray region was one of the most victims of the Dergue policy which frequently contribute to food insecurity in the region. Furthermore, Glantz states that the government has frequently followed inappropriate food policies, given agricultural research low priority, as in Northern Ethiopia (*which is specifically Tigray*) used crop failure as a military weapon (Glantz 1987). Past governments were not committed to denying poverty and food security a future and did not step to address the causes of poverty and food insecurity rather policy choices were made to use it as a weapon.

Lack of democratic governments which are responsive to the needs of all their citizens and make food security a high priority, and to welcome community participation were the main causes for the exacerbating condition of food insecurity in the region. There were no programs aimed at fostering broad-based agricultural and rural development that should have been implemented within an appropriate policy context. This includes good governance - the rule of law, transparency, sound public administration, democratic and inclusive decision making, and respect for human rights. The poor and food insecure people in the region were deprived of their political voice and organizations that are accountable to them and capable of articulating their interests to policymakers and other power holders. In general past government's inappropriate policies and decade's long civil war in the region

were the major sources food insecurity and the factors for exacerbating the loss of assets, destruction of social and physical infrastructures.

As it is presented in Figure 14 majority of the food insecure populations are found in the eastern and southern parts of the region. Identifying spatial similarities of both food insecurity and contributing factors is useful for designing spatially targeted interventions for alleviating food insecurity and thereby poverty. Thus, a discussion is made below whether there is spatial clustering of food insecure districts or not and the factors contributing for spatial clustering.

#### 5.4. Poverty Density

Based on the proportion of food insecure population across district obtained from Disaster Prevention and Preparedness Commission, Aheferom, Ganta Afeshum and Adewa districts have significantly higher food insecure people. The food insecurity density map, the number of food insecure people per square kilometre, gives spatial information on the concentration of food insecure people across the districts. The food insecurity density map represented in Figure 15 below shows that while some districts, such as Aheferom, have the highest food insecure people, they also have the lowest food insecurity density or concentration of food insecure people. As it is indicated in the figure the concentration of food insecure people in the western part of the region is almost negligible which is less populated and the most productive zone in the region. A larger number of food insecure populations are found in the eastern and southern parts of the region.

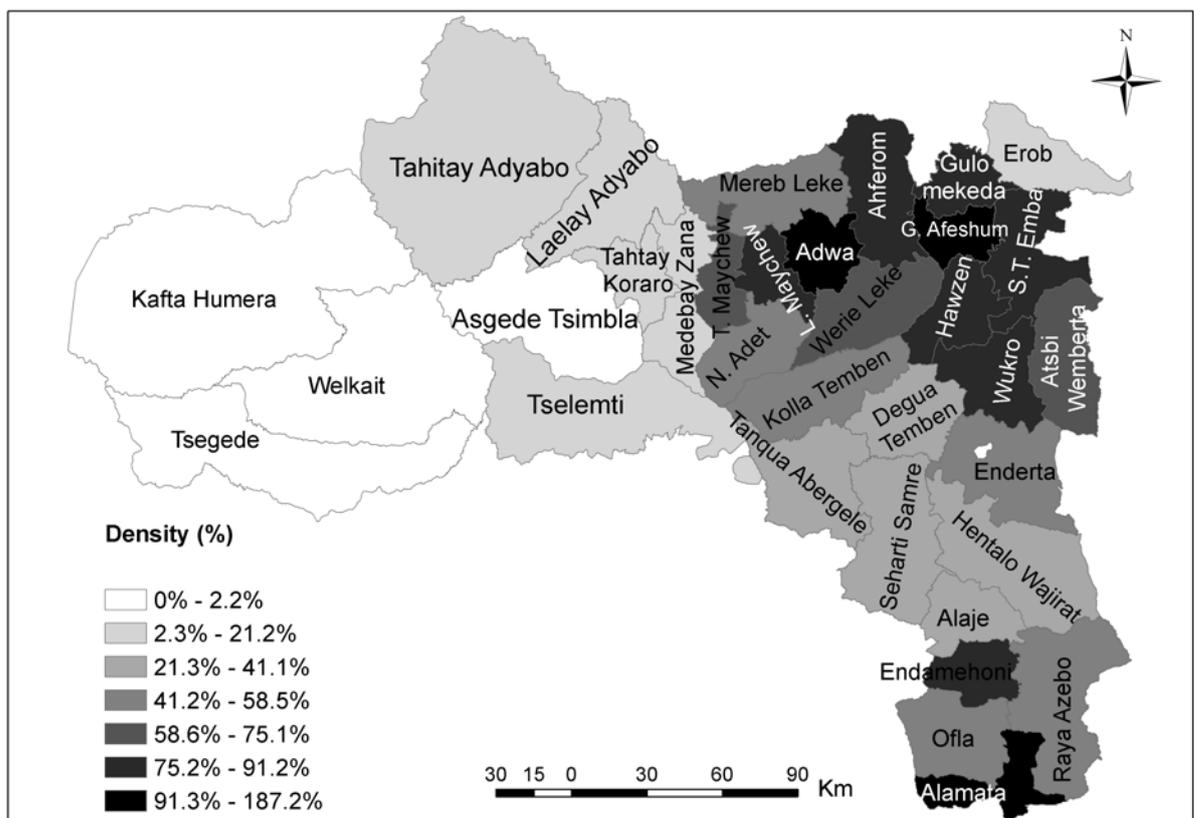


Figure 15 Food insecurity density: the number of food insecure people per km<sup>2</sup>

## 5.5. Spatial Clustering of Food Insecure Areas

Do food insecure (poor) people or food secure people in Tigray live close to each other? Are there clusters of districts in Tigray with high or low concentration of food insecurity? Spatial clustering shows spatial similarity or dissimilarity of food insecurity in neighbouring districts. Two types of spatial similarity exist: food insecure districts mainly surrounded by food insecure districts or high-high food insecurity clustering, and food secure districts mainly surrounded by food secure districts or low-low food insecurity clustering.

The local spatial autocorrelation, measured by local Moran's I statistic (Anselin 1995), indicates the strength of the spatial similarity or dissimilarity of neighbouring districts. Local Moran's I is positive for both high-high and low-low similarities and is negative for both high-low and low-high spatial dissimilarities. Figure 16 below shows the districts with spatially similar or dissimilar neighbourhoods.

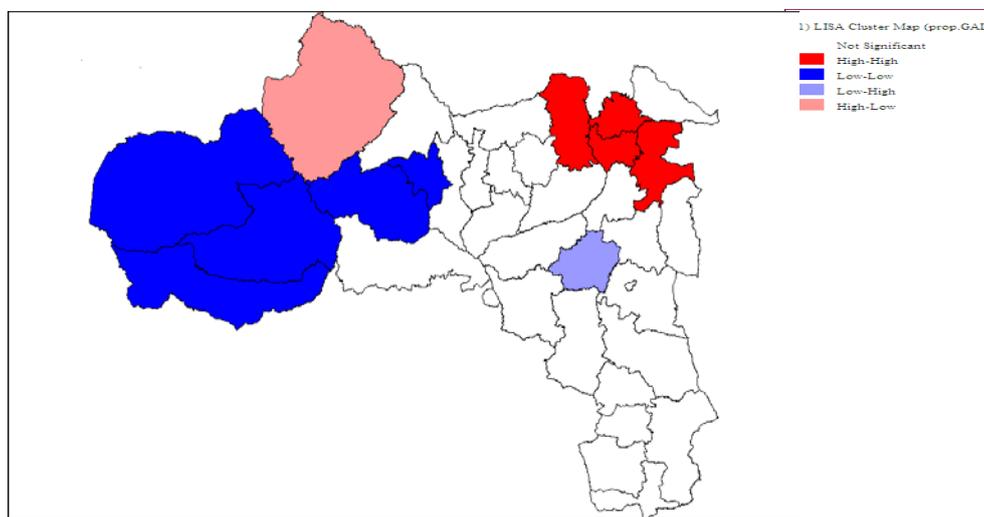


Figure 16 Districts with spatially similar or dissimilar food insecure neighbourhoods

As it is depicted in Figure 16 above there exists spatial clustering among the districts. To analyze the strength of the spatial clustering among the districts test for spatial autocorrelation is vital. Global Moran's I statistic measures the spatial autocorrelation which shows whether the spatial similarity of neighbourhood units in the whole region is significant or not. Moran's I is computed to test for the spatial autocorrelation and significantly high positive value confirms positive autocorrelation or spatial clustering. As it is indicated in Figure 17 below the calculated Moran's I statistic, the slope of the regression line, for the proportion of food insecure households is found to be 0.51 which is statistically significant. Positive Moran's I indicates the presence and degree of spatial autocorrelation or over all clustering that confirms the hypothesis that food insecure (or food secure) districts are often surrounded by food insecure (or food secure) neighbours'.

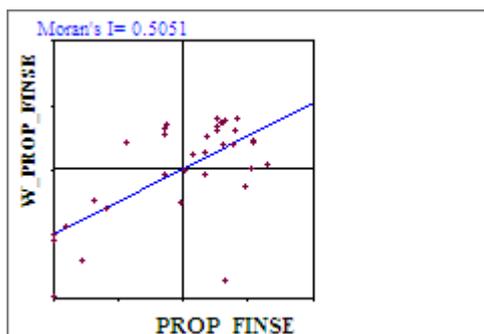


Figure 17 Scatter plot of proportion of food insecure population

To check how spatial is Moran's I and whether it is significantly different from expected value or not, a test of hypothesis is employed at 5 percent significance level.

Moran I statistic standard deviate = 4.5803, p-value = 2.322e-06

alternative hypothesis: greater

sample estimates:

Moran I statistic	Expectation	Variance
0.5051	-0.0303	0.01234

To test the above hypothesis a z-test statistic,  $z = \frac{I - E(I)}{S_d(I)}$ , is computed and a value of 4.819 is

obtained which is significant at 5% and the hypothesis that there is no spatial autocorrelation is rejected.

The identification of spatial clusters of similarities or dissimilarities has many advantages. First, it helps locate similar and dissimilar neighbourhoods and their influence on the incidence of food insecurity. Second, it could identify physical, social, economic and institutional factors that contribute to similarity or dissimilarity. Third, it helps design effective, spatially targeted interventions that can trigger a higher rate of poverty alleviation within a district than the intervention designs at the regional level.

## 5.6. Determinants of Spatial Clustering

Do spatial similarities influence the level of food insecurity? And what are the factors matters in spatially similarity or dissimilarity? Specifically do availability of water (rainfall), land holding size, agricultural population pressure and productivity matter in spatial similarity of food insecure or food secure districts and to what extent do they matter.

Most people in Tigray live in rural areas and their livelihood mainly depend on agriculture. Thus the availability and access to water, land and infrastructure are crucial factors for the livelihood of the poor people. Intra-annual rain variations are severe constraints to productive agriculture in districts of the region. Thus, in many districts, a small quantity of irrigation scheme is required to supplement water deficit during the main rainy season and access to irrigation is necessary to ensure food security and thereby reducing poverty in rural areas. The government in the past have heavily invested in new irrigation infrastructure and water harvesting activities such as construction of ponds and hand dug wells as irrigation investment has been the major plank of rural development, poverty reduction and food security strategy. While some districts benefited from these investments and others are not.

It was assumed that the main factors that influence food insecurity and clustering of food insecurity are availability and access to water such as area under irrigation per district and rainfall, average land holding per household per district, and access to infrastructure such as average distance to all weather roads and average distance to main markets. However, at the level of aggregation of districts the exact information on distance to all weather roads and market canters and area under irrigation scheme is not available. Thus, due to lack of available data factors such as average landholding, rainfall, per capita production and agricultural population density per district are only considered. The influence of these factors and the spatial clustering of food insecurity of the districts are assessed using ordinary least square regression method. Then the influence of spatial similarity of the neighbouring districts on the levels of food insecurity of the districts is assessed by employing conditional auto regression model.

Looking with simple mapping and geo-visualizing at some of the factors such as average land holding size and per capita grain production per district shows that there is similar strong spatial clustering as it is shown in Figure 18 and Figure 19 below.

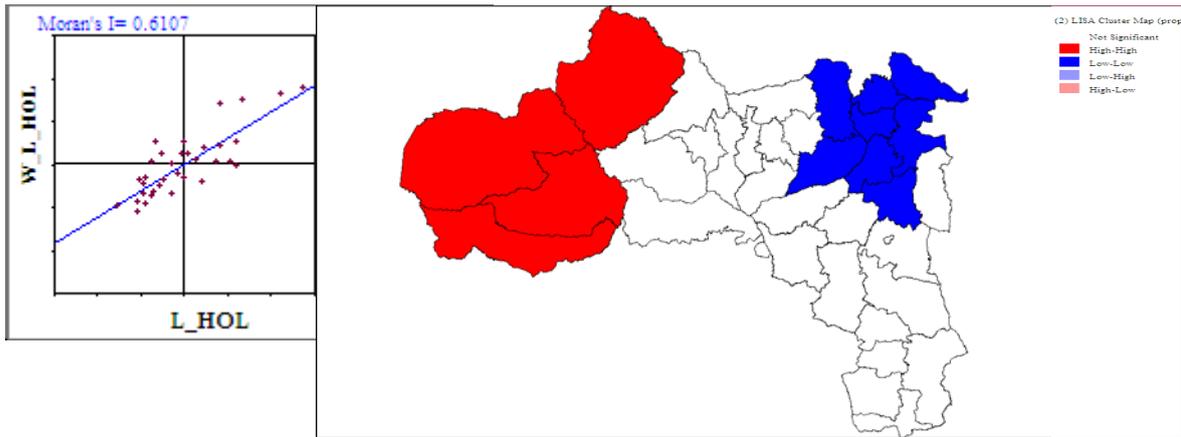


Figure 18 Districts with spatially similar or dissimilar landholding neighbourhoods

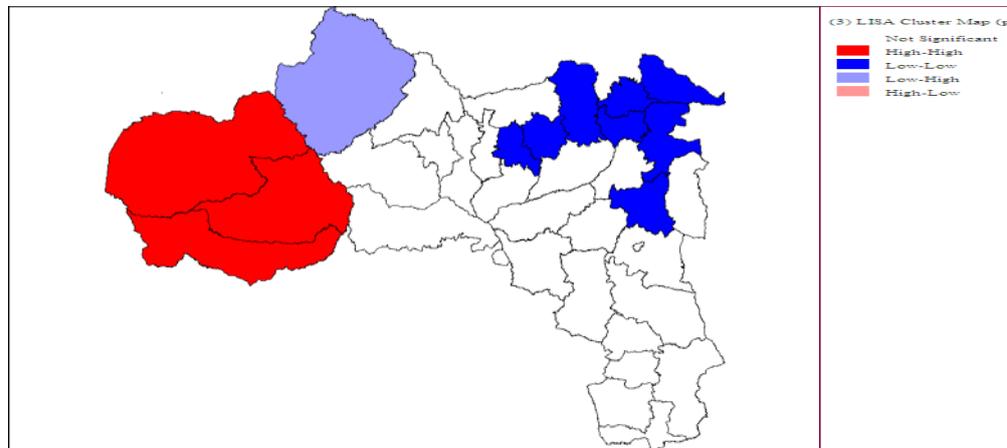


Figure 19 Districts with spatially similar or dissimilar per capita cereal production

To analyze the factors contributing to the spatial clustering of food insecure population in the region a spatial regression model is fitted. First factors such as average land holding per district, agricultural population density, rainfall and per capita grain production per district was taken to fit the model. Based on these data the influence of spatial similarity or dependence of the neighbouring districts on the levels of food insecurity of the districts is discussed as outlined below.

The influence of the factors on the levels of food insecurity and the spatial clustering of food insecurity of the districts is first assessed using ordinary least square (OLS) regression where proportion of food insecure population as a dependent variables and average landholding (L\_HOL), per capita cereal production (PER\_CPROP), rainfall (MEH\_RFALL) and agricultural population density (AG\_DENS) as explanatory variables. The summary of output for the OLS estimates is given in Table 3 below.

Table 3 OLS Parameter estimates

Variable	Coefficient	Std.Error	t-Statistic	Probability
CONSTANT	59.8408	14.73578	4.06092	0.0003390
L_HOL	21.0985	9.2025	2.2927	0.0293084
MEH_RFALL	-0.02904	0.01209	-2.40187	0.0229418
AG_DENS	0.00435	0.009893	0.43936	0.6636550
PER_CPROD	-0.17476	0.03319	-5.26403	0.0000122

R-squared: 0.709432 F-statistic: 17.7011 Prob(F-statistic):1.86067e-007  
 Adjusted R-squared: 0.6693 Log likelihood: -129.048

As it is indicated in the table above the regression model is significant since probability of the F-statistic is much lower than 5% significance level. This means that at least one of the factors contribute to spatial clustering. The adjusted coefficient of determination ( $R^2$ ) of OLS measures the extent to which the predicted values match the observed values for the dependent variable and  $R^2$  is found to be 67% which is much higher and thus good model fitting. To check the significance of the individual regression coefficients, it can be estimated by dividing the coefficient ( $\beta$ ) by its standard deviation provided in **Table 3** above, follows a t-distribution with n (number of observations – number of parameters estimated in the model) degrees of freedom. Then the probability, p, of the t-statistic is checked and the coefficient is considered as significant if  $p < 0.05$  at 5% significance level. As it is shown in **Table 3** the coefficients for land holding, rainfall and per capita production is different from zero at 5 percent significance level.

To test whether there is spatial autocorrelation and spatial dependence, a Maximum Likelihood Spatial Lag model is fitted as shown below.

$y = \rho W_y + X\beta + \varepsilon$  Where y: dependent variable (proportion of food insecure population per district, X is explanatory variables,  $\beta$  is regression coefficient,  $\varepsilon$  is random error term,  $\rho$  is spatial autoregressive coefficient and  $W_y$  is spatially lagged dependent variable. The hypothesis here is that the spatial clustering of the indicators of average land holding, rainfall, per capita production and agricultural population density do not influence the spatial clustering of districts with varying levels of food insecurity. The output for the maximum likelihood estimation of the spatial lag model is given below.

Variable	Coefficient	Std.Error	z-value	Probability
W_PROP_FINSE	0.42572	0.15492	2.748045	0.0059953
CONSTANT	24.7478	17.4862	1.415274	0.1569882
L_HOL	29.8449	8.03507	3.714326	0.0002038
AG_DENS	0.00713	0.00834	0.854931	0.3925890
PER_CPROD	-0.17311	0.02777	-6.232999	0.0000000
MEH_RFALL	-0.01906	0.01022	-1.864498	0.0622517

Lag coeff. (Rho): 0.425721 R-squared: 0.769800

TEST	DF	VALUE	PROB
Likelihood Ratio Test	1	6.32543	0.0119019

To diagnostic for spatial dependence Likelihood Ratio Test (LR) on  $\rho$  (= twice the difference between the spatial lag model and log likelihood in a standard regression model with the same set of explanatory variables, i.e.  $\rho$  set to 0) and its associated probability. The likelihood Ratio Test (LR-6.325) on this parameter is highly significant (p-0.0119) at 5% significant level. Moreover, the spatial autoregressive parameter (Rho-0.426) is highly significant at 5 percent significance level as indicated by the p-value of 0.005. Thus, we reject the null hypothesis that there is no spatial auto regression.

Finally estimation of the spatial error model is also supported by means of the Maximum Likelihood Method (M). The outputs of the model are outlines below.

**REGRESSION****SUMMARY OF OUTPUT: SPATIAL ERROR MODEL - MAXIMUM LIKELIHOOD ESTIMATION**


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Variable	Coefficient	Std.Error	z-value	Probability
CONSTANT	57.3735	13.3298	4.30415	0.0000168
Land Holding	22.4486	6.50291	3.45208	0.0005564
Rainfall	-0.0217	0.00898	-2.41841	0.0155884
PER_CPROD	-0.1833	0.02458	-7.45742	0.0000000
AGR_DENS	-0.00049	0.00805	-0.06113	0.9512593
LAMBDA	0.61431	0.14815	4.14656	0.0000338

---

Lag coeff. (Lambda): 0.614305 R-squared: 0.794247

**DIAGNOSTICS FOR SPATIAL DEPENDENCE**

SPATIAL ERROR DEPENDENCE FOR WEIGHT MATRIX:

TEST	DF	VALUE	PROB
Likelihood Ratio Test	1	8.009704	0.0046527

The above regression result revealed that the estimate for the spatial autoregressive coefficient ( $\hat{\lambda} = 0.614$ ) is highly significant at 5% significance level since the p-value is much lower than the critical significance value. The likelihood ratio test (LR, 8.01) on this parameter is also highly significant at 5 percent level of significance. The coefficient for agricultural population density has become insignificant as it is also revealed in the OLS estimate. The findings of the regression revealed that land holding, rainfall and per capita production are among the contributing factors for the spatial clustering. Therefore, the identification of spatial clusters of similarities or dissimilarities and their contributing factors helps public policy makers to design effective, spatially targeted interventions that can trigger a higher rate of poverty alleviation within a district than the intervention designs at the regional level.

**5.7. Coping and Survival Strategies**

Households are not passive victims of the problem of food shortage. Based on their capacity or available capital and opportunities they try to implement different strategies to handle the stress situation. Strategies used by households in response to declining availability or entitlement of food in abnormal seasons of the year are coping strategies. These households' strategies are used to minimize the impact of livelihood shocks. On the other hand when households are becoming more and more vulnerable, their strategies are limited to survival or to combat destitution and death. Those strategies that are used to combat destitution and death are survival strategies.

The main coping strategies adopted by rural communities in Tigray region are selling of assets, petty trading, wood selling, and agricultural diversification. Selling livestock asset is an important mechanism for coping food shortage in the region and results of the household survey also revealed that 62 percent of the studied households used to sell their assets during seasons of food shortage. However, selling of available assets including livestock repeatedly as a coping strategy weaken households' resource base and exposes them to permanent food insecurity. Once households faced the problem and have sold assets of what so ever, it will take some years to recover these assets. This

indicates that if seasonal food insecurity occurs repeatedly, it depletes the available resource base and exposes households to permanent food insecurity.

Agricultural diversification is also an important coping strategy. In all the six Tabia's visited respondents explained coping with the problem by using different agricultural practices. Farmers try to increase their agricultural production by cultivating two crops in one rain season. They practice multiple cropping, use irrigation.

Some of the main survival strategies that are experienced by rural communities are out migration, social networks and support from relatives or friends, daily labour, food aid, and reducing daily meal. The other important means of earning small income or a means of getting daily meal for the destitute is engaging in daily labour. Many people have also been depending on food aid for their survival and food aid is considered as a standard response to transitory food insecurity like drought emergencies. The results of the household survey further revealed that 89 percent of the studied households are involved in different food for work activities and received cash or food for their work. Decreasing the amount of daily meals is also one response that the food insecure households use to mitigate the impact of food crisis. They try to decrease both the amount and quality of food consumed during the problem food shortage. The last alternative for some disabled and ill-health people who had finished all their available resources and faced critical food shortage is begging.

## **5.8. Conclusion**

A large segment of population in Tigray is chronically or seasonally food insecure. The underlying causes for households food shortage in the region are quite complex. It is induced by natural factors and compounded by man made processes. A combination of natural factors, socio-economic limitations, and institutional weakness and inappropriate policies are altogether responsible factors. However, factors particularly natural causes vary from place to place. In the highland areas the prominent problems of farmers are environmental degradation while in the lowland areas drought and crop pests are dominant natural problems.

There are also socio-economic limitations which are prominent in the region. These include population pressure, shortage of farm land and other productive assets, poor infrastructural services such as marketing, consumable agricultural inputs like improved seeds, and transport. Past government's inappropriate and discriminatory policies were also the major barriers to increased food security and economic development in the region. Furthermore, it is observed that there is spatial clustering of food insecure districts.

Realizing the magnitude and severity of food insecurity/livelihood challenge, the regional government has developed food security policy under the framework of the national government's overall development policy to address the problems of food insecurity in the region. Accordingly different programs have been carried out since 2000 to address food insecurity at household level. Thus, government's intervention carried out to achieve food security is necessary to evaluate as to how these intervention mechanisms are effective in addressing food insecurity. These issues are discussed separately on the following chapter.

## **6. Government Intervention Mechanisms to Address Household Food Insecurity**

### **6.1. Introduction**

Governments' intervention mechanisms to achieve household food security in the past decades were very much limited if not non-existing in the country. The current government has a sustainable development and poverty reduction program which emphasizes achieving household food security as its top priority. Accordingly, different development programs and activities have been carried out in this regard since 1999/00.

This chapter assesses government intervention mechanisms carried out to address household food insecurity and their impact in bringing changes on the livelihood of households. These policies and strategies are evaluated against the three main components of food security which are food availability, access to food and utilization. This is basically analyzed based on the official governmental reports and figures collected during field work.

### **6.2. Policy Framework**

During the pre 1974-feudal and Dergue 1974-1991 regimes, policies and strategies to promote agricultural production and food security were limited or non-existent. The country has suffered from misguided economic policies under the socialist Dergue regime, which ruled from 1974 until 1991. When the current government replaced the Dergue regime in 1991, a number of market oriented reforms were implemented; some aimed at stimulating agriculture and rural growth. The government has adopted the Agricultural Development Led Industrialization (ADLI) as its overall development strategy, which emphasized the role of the agricultural sector as a catalyst for immediate food security improvement and long-term, broad economic growth. More than 85% of the country's population live in rural areas, where agriculture is the main economic activity and where the poverty ratio is particularly high; hence emphasis on generating rapid growth in the agricultural sector to curb poverty and hunger is the government's priority. To this end, the government not only continued to support ADLI strategy but also launched a series of development and poverty reduction programs, including the Sustainable Development and Poverty Reduction Strategy and programs, and the Food Security program.

Food security is among the governments priority areas of development strategy. The initial implementation period of the policy was from 2000-2005. The strategy relies on three aspects: increasing the availability of food through domestic production, ensuring access to food deficit households and strengthening emergency response capabilities of relevant institutions (FDRE 2002). The strategy states that both the supply and demand side of the food equation i.e. availability and entitlement will be addressed at national and households levels. It is also indicated that particular attention will be given to the diversity of food production zones (areas with adequate moisture and moisture deficit) to tailor options and strategies depending on the situation. Expansion of investment activities in health, education and road facilities to rural areas as supportive mechanisms are emphasised in the rural development strategy. The food security strategy is well developed as part and parcel of the poverty reduction strategy of the country.

The food security policy's specific purpose is to provide clear guidance regarding the strategies and measures that must be adopted in order to improve food security for all people in the region. At the same time, it is aimed to support related initiatives on reducing poverty. The long-term goal of the

food security policy is to ensure that “All people in Tigray at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs for an active and healthy life”. The regional government has established annual income of 18,000 Ethiopian Birr as a benchmark for a household to be food secure. The log framework of the policy is outlined in Figure 20 below.

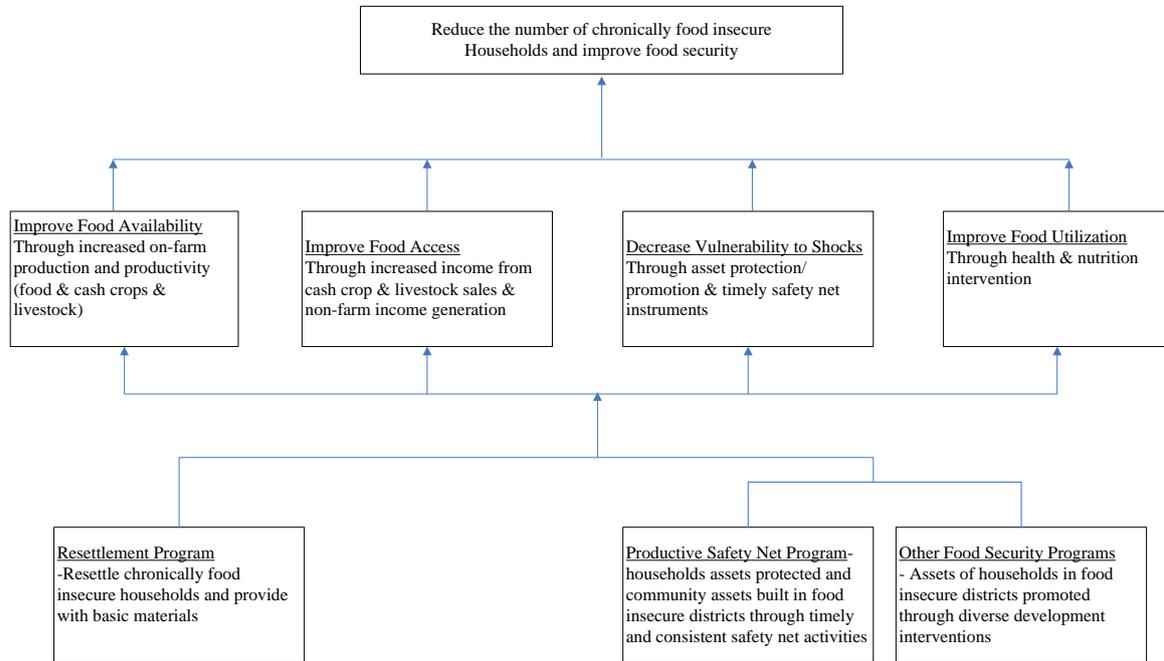


Figure 20 Policy Tree

The primary aim of this policy evaluation on food security is to assess the impact of government’s intervention in improving the lives of the poor. That is to assess whether the food security programs carried out have achieved their intended objectives. To do this, it is tried to assess outcomes with the program in place and compare them to outcomes without the program (i.e. the counterfactual). As it is discussed in the literature section 2.4, a before-and-after design is employed for the evaluation design to assess the changes in food security policy level indicators. Time series data on various food security indicators that extends to several years before the implementation of the policy and several years after the policy is implemented is considered to look for an ‘interruption’ or ‘shift’ in the time series at the time the policy is introduced and to check that the shift is sustained over time. Thus, long-term time series (10years) analysis is carried out based on official governmental reports and figures. The before-and-after evaluation on the main food security policy level indicators (increased stability of food supply, increased availability of food, access for all supplies and more effective utilization) which are the main components of food security is discussed below.

### 6.3. Interventions made to Ensure Food availability

Food availability is one of the three conditions of food security as defined in the World Food Summit. Food security at the regional level is determined by the availability of enough resources for the whole population. The most widely used indicators are quantities of available food compared with needs. Availability is a function of domestic production, imports, food aids and security stock. Of these, domestic production is critical in ensuring food availability at both regional and household levels. Therefore, domestic production of food grains is considered to evaluate government’s effort made to boost production and ensure food security. What are the interventions put to increase production and of other important food crops as well as livestock? What are the effects of the interventions in terms food security and self reliance both at regional and household level? These questions are analyzed below.

### 6.3.1. Increasing Agricultural Income

Majority of the food insecure population lives in the rural areas. Increasing agricultural production is the first and main source of food entitlement for most of the farming community in Tigray in terms of direct consumption of food. Therefore, increasing the production and productivity in a sustainable manner could address the problem of food shortage. Increasing food production contributes to food security within communities and nations by making more food available and by generating employment and income. To increase agricultural production and productivity, government's interventions are mainly focused on expansion of extension services and utilization of water resources. These have been implemented in conjunction with the overall reform programs that has strong impact on the revival of the sector. The main government interventions employed to increase production and productivity are discussed below.

#### 6.3.1.1. The Extension program

The government has introduced a new extension program known as a participatory demonstration and training extension system with the aim of increasing agricultural productivity. Extension programs carried out includes crop extension, livestock extension, and natural resource conservation and protection. Crop extension including fruit and vegetables is the main component of extension programs. In this extension program emphasis is made to encourage farmers to use fertilizers, improved seeds and other agricultural inputs. At the district level, the extension program is organized in such a way that every tabia will have three development agents with specialization in crop cultivation, natural resource protection and conservation, and animal husbandry.

Many reports indicate that extension programs in the region have been successful in terms of the participation of farmers. The Tigray Region Bureau of Agriculture and Rural Development report indicates that extension programs in the region have increased in terms of number of participant farmers and services rendered. The program started by including 20,000 farmers in its first year in 1994/95 and expanded rapidly during the period 2000-2005 where 403,889 farmers are covered by the program. Development agents were also assigned in each tabia (lowest administrative level) so that these agents train farmers by demonstrating practically the benefit of the package.

#### a) Efficient Utilization of Water Resources

Water is one of the most critical resources for crop production in the moisture deficit areas of the region and is one of the main causes for the household food insecurity in the study area. Thus, water harvesting is regarded as the main pillar of national food security strategy in Ethiopia (FDRE 2002).

In an effort to address the problems of recurrent droughts and food insecurity the government of Tigray Regional State has given priority to a variety of water harvesting programmes to supplement the rain fed agriculture. Water harvesting is considered as the single most important means to increase agricultural productivity and address the problems of water shortage in the drought prone areas of Tigray. Thus, different interventions has been undertaken to utilize the available water resource for agricultural purposes and secure households particularly in moisture deficit areas of the region.



Figure 21 Water harvesting scheme constructed at household level

Notable among these is the extensive small dam-based irrigation program. During the past years about 60 micro dams have been built and being functional. The program also intended that each farmer should have a well developed water harvest scheme. This has led to increased focus on the construction of ponds, river diversions and water wells. Extensive pond construction and digging of water wells has been undertaken in the region since 2002 to provide for irrigation at a household level and to create households an opportunity to supplement the rain fed agriculture and use it for vegetable production in their garden. Accordingly, 18562, 22218, 36743 and 24014 totalling 101, 537 pond schemes were constructed during the period 2002-2005 respectively; of which 65.74% of the ponds constructed are being functional. It is observed that this makes cultivation of crops twice or more a year possible, as well as the possibility for supplementary irrigation when rain stops early. Moreover, this had given an opportunity for farmers' access to water resource and to shift to high value crops with an increased likelihood of using improved inputs due to reduced risk of crop failure and increased yield due to input complementarities; and thereby lead to higher income.



Figure 22 Water well constructed at household level with his treadle pump growing fruits on his garden, which is an essential element of the intervention. Photo by Tagel

Vulnerability to food insecurity in Tigray is also increasingly associated with variability in the reliability of water availability for food and agricultural production. Thus, the construction of small-scale irrigation scheme has helped to improve cropping intensity thereby reducing the effect of erratic rainfall. Traditional river diversion schemes and small-scale irrigation schemes were constructed in different part of the regions. The area under irrigation has increased from 4773ha in 2000 to 20,570.51ha in 2006. Available evidence suggests that small-scale, village-based dams and irrigation systems may be suitable, cost-effective and sustainable in smallholder farmer circumstances. It is observed that with the build of many small-scale dams and increasing trends in irrigation the livelihoods of the communities where irrigation activities are carried out has been improving.



Figure 23 Photo showing micro-dam for small-scale irrigation scheme in Hintalo Wajerat district, tabia Ara-Asegeda

In summary, water harvesting and utilization strategy has been an area of focus by the government over the past years and efforts have been continuously made to expand it. It was observed that utilization of available water for agricultural purpose is indispensable to secure households food situation particularly in moisture deficit areas and the water harvesting schemes has been effective and useful in enduring household food security. Thus, improvements in water use efficiency had helped the region better manage its limited water resources and to avert crop damage and the recurrent erratic rainfall and dry spell condition which often result in crop failures in Tigray. However, the water harvesting scheme program implementation is not without problem. The water harvest and utilization program especially construction of ponds and water wells have been implemented in mass base without prior awareness and acceptance of the farmers on the technology.

### b) Input Supply

One of the major components of the extension package is the use of fertilizers. As indicated, the most plausible way to eradicate poverty is to increase food supply in the region and create the opportunity for people to attain food security. One of the means that has been followed to expedite the availability of enough food, which has been the obsession of the regional government, has been the increased use of fertilizers by smallholding farmers. The fertilizer sector has been supported by the Government through the development of policies that support and strengthen the input distribution and marketing sector. The regional government and micro-financing institutions have been made efforts to provide credit to encourage farmer's access to fertilizers.

Table 4 shows the fertilizer sales of the region for the last 11 years. Fertilizer consumption has experienced a steady rise through the years to peak in 2001 with 16,616MT sold. However, the fertilizer use dropped after 2001. Fertilizer use in 2002 is nearly half of the region's 2001 peak quantity. This reduction is attributed to increase in input prices where more expensive transportation costs kept prices higher, lack of a competitive fertilizer market sector, substantial farmers were not able to get their investment back because of the recurrent drought in 2002 and generated a loss of confidence to continue to buy-into the credit schemes, and due to the erratic and insufficient rain conditions farmers are still sceptical about the technology.

Table 4 Fertilizer sale and retail price variations in ETB/Qt from 1995 to 2005

YEAR	FERTILIZER CONSUMPTION IN MT	FERTILIZER PRICE (BR.)	
		DAP	UREA
1995	4,491		
1996	6,950		
1997	12,080	252.00	237.50
1998	14,576	255.00	210.00
1999	15,108	272.00	182.50
2000	12,718	308.00	201.00
2001	16,616	282.00	202.00
2002	8,976	268.00	217.50
2003	14,895		
2004	9,137		
2005	7,207		

The other component of the extension package is the use of improved seeds in the effort to boost production. The amount of improved supplied has been gradually increased over the period 2000-2006. However, the amount of improved seed delivered so far is inadequate when compared with total crop area covered. The growth of available improved seeds and their marketing has been unsatisfactory. Narrow alternative improved seeds, lack of availability and poor marketing systems, and recurrent droughts occurred are also detrimental to the number of farmers willing to incur further debt by investing in inputs such as improved seeds.

### c) Livestock Development

A generally accepted indicator and underlying determinant of poverty in Ethiopia is livestock ownership, although its role in the different livelihood systems may be different. Oxen are crucial in ox-plough farming systems in most parts of the region. In the other farming systems, where oxen are less important for traction, livestock provide a very important source of additional income, via milk and meat, etc. In all farming systems, livestock are the single most important store of wealth.

According to livestock censuses, the livestock population includes 3 million cattle, greater than 2.4 million sheep and goats, around 2.3 million poultry, 184,517 bee colonies, 318,932 draught animals and 13,661 camels. The ruminant animals are mostly reared by smallholding farmers and are mixed with crop productive activities. Basically, these smallholding farmers keep these animals for security purposes, mostly reserved for times of hardship so that they may sell their animals to buy food and other essential items. In some cases, these animals are reared as a small investment to enable farmers to earn extra income. Realizing their importance, livestock development has been given due emphasis by the regional government so that the livestock sub-sector could contribute its share to the efforts made to ensure food availability and security in the region. These different activities have been undertaken under the livestock extension program components such as animal feed and forage production, improvement of animal health and betterment of livestock breed. Governmental report revealed that 4130, 66427 and 291053 better breeds of cattle, bee colonies and chicken respectively were provided to farmers during the period 2002-2005 and loan was also provided to farmers who want to participate in dairy production, fattening and raising cattle, sheep and goat. Though, the government has strengthened its effort to promote the sub-sector, lack of enough grazing land and fodder are the main problems associated with the sub-sector. However, it is observed that the program is playing its role as an important source of livelihood and income and thereby improving food security of farmers in the region.

### d) Natural resource conservation

The other extension program in the region is natural resource conservation and protection. Natural resource degradation like soil erosion is severe in the region and constrains agricultural production. Food insecurity has been exacerbated by environmental degradation from extensive deforestation and land over-exploitation. Different community support activities aimed at developing the agro-economic infrastructure necessary to combat the challenges of drought have been carried out over the past years. A vast area of land is covered with soil and water conservation (terraces, area enclosure, tree planting, gully reclamations, etc) to rehabilitate the degraded land. It is observed that there are encouraging experience with area enclosures in different parts of the region as indicated in Figure 24 below, the impact being the restoration of vegetation, including indigenous species and increase of available fodder. Farmers also started to value such areas for honey production.



Figure 24 Tigray–Hintalo (one of the study site): land rehabilitated due to area enclosure Photo by Tagel

It is also observed that communities are empowered to administer, enhance and utilize their common resources. Almost all districts have one or more participatory forest management agreements. Forests are protected with bylaws that have been agreed upon by communities and participation of local community was given due emphasis in the management and rehabilitation of common resources.

Cultivated land is protected through stabilizing terraces by planting multipurpose trees and constructing stone trench bunds as it is shown in Figure 25 to capture both water and soil and prevent soil erosion. This system has helped to improve both soil fertility and crop yields in addition to preserving the natural environment around farms. Besides, these activities are relevant for combating desertification through mitigating the effects of drought by preventing free-range grazing to increase forage productivity and encourage natural regeneration and have resulted in quick overall land rehabilitation in areas visited.

It is also observed that in view of the magnitude of environmental threat, emphasis given by the regional government to soil and water conservation and environmental rehabilitation at large, have a significant impact on agricultural development and food security.



Figure 25 Constructed stone bunds to prevent soil erosion

In summary governmental figures and reports show that a lot of interventions have been accomplished to improve the performance of smallholder agriculture. But do these interventions result in any change on food availability? The results of the interventions are discussed below.

#### 6.4. Impacts on Food Availability

**A) Domestic production:** Domestic food grain production in the study region is the major source of food supply and fluctuations in production are a major cause of instability in food availability. The before-and-after assessment on food production shows that food grain production has decreased annually at an average of -2% in 1997-2000 as it is depicted in Figure 26 below. This is because of the outbreak of conflict with Eritrea between 1998 and 2000 and this had caused displacement of people from their farms. Thereafter the regional crop production is growing annually at an average of 10.8% from 2000-2006 percent coupled with growth of institutional infrastructure and positive shift in public policy. The highest growth rate was registered in 2006 where the production outstrips by 14.4% the annual grain demand. It is also observed that the increased in production was not due to the expansion of cultivated land; it is generally attributed to the sectors structural transformation as a result of encouraging policies.

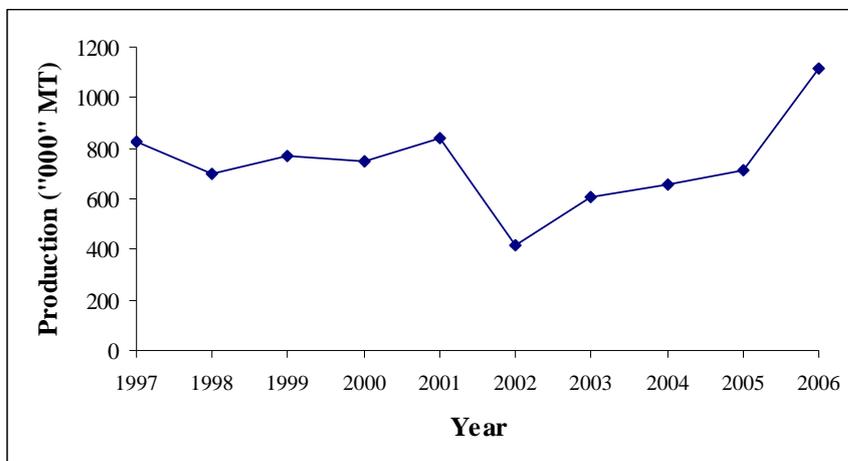


Figure 26 Trends in Crop production, 1997-2006

Based on the available data, a Food Balance Sheet (FBS) is computed for the period 1997 - 2006, using 2100 calories of food per day as the minimum nutritional requirement. This is equivalent to 225 kilograms of cereals per person per annum. FBS are the principle tool used for calculating national food security, which are used to determine the expected food deficit or surplus, the necessary food import requirements, and food aid requirements (Frankenberger 1992).

**Table 5** below reveals that food requirement in Tigray grows at 2.5 percent while the food availability increased by 8.1 percent. As a result, the food deficit declined by 8.4 percent. The self sufficiency ratio (SSR), which is measured as the ratio of the sum of net production of cereals and other food sources to the requirement of food, has increased by 9.1 percent. The self-sufficiency ratio expresses magnitude of production in relation to domestic utilization. Based on the official food grain production figures the food grain SSR for Tigray is gradually increasing. The lowest self-sufficiency rate is found in 2002, which is attributed to the crop failure due to the severe drought occurred all over the country and boarder conflict between Eritrea. Moreover, the food availability ratio which is the ratio of the total supply to the requirement has also increased by 9.1 percent.

Table 5 Food Balance Sheet for Tigray Region (2000 – 2006)

SI No	variable	2000	2001	2002	2003	2004	2005	2006	Growth rate
1	Production of cereals (in Qts.)	7483713	8433379	4140014	6081356	6578878	7150448	11159164	11.66
2	Less 15% Post harvest loss	1122557	1265007	621002	912203	986832	1072567	1673875	
3	Less 6% seed	449023	506003	248401	364881	394733	429027	669550	
4	Net production	5912133	6662369	3270611	4804271	5197314	5648854	8815740	11.66
5	Food Aid	98338	13414	265144	181498	66563	-	-	
6	Total grain available	6010471	6675783	3535755	4985769	5263877	5648854	8815740	10.57
7	Total supply	6010471	6675783	3535755	4985769	5263877	5648854	8815740	
8	Total population	3694700	3797000	3901000	4006000	4113000	4223000	4335000	
9	Food requirement at 2.25Qt per HHs	8313075	8543250	8777250	9013500	9254250	9501750	9753750	2.47
10	Food Balance	-2302604	-1867467	-5241495	-4027731	-3990373	-3852896	-938010	8.4
11	Self Sufficiency Ratio	0.7112	0.7798	0.3726	0.5330	0.5616	0.5945	0.9038	9.10
12	Food Availability Ratio	0.7230	0.7814	0.4028	0.5531	0.5688	0.5945	0.9038	8.05

As the figures from the Food Balance Sheet reveal, the food availability and regional food self sufficiency is increasing over the period 2000-2006. Food security at regional level, i.e., self-reliance in food at the regional level does not necessarily mean food security at the district level. Food supply indicator at the regional level can provide some useful information regarding trends in food availability but they are often too aggregated to detect pockets of food deficit or vulnerability in a given district. Similarly, Food Balance Sheet is not usually drawn upon a disaggregated basis to detect differences across districts or regions (Davies et al. 1991a) cited in (Frankenberger 1992). Thus, conclusion can not be drawn on the spatial effect of policy on food availability across districts based on regional Food Balance Sheet only. Thus, looking at the spatial difference across districts by disaggregating the availability of food is vital.

To analyze the spatial effect of government interventions made to improve agricultural productivity across all districts, Food Balance Sheet for the period 2000-2006 for all 34 districts is computed. The result reveals that improvement in food availability ratio has been observed in all districts except Naeder Adet and Laelay Maichew districts where the food availability ratio is decreased by 1.8 percent 4.1 percent respectively. The self sufficiency ratio, which is measured as the ratio of the sum of net production of cereals has shown increment for all districts over the period considered. Despite fluctuations in drought periods, improvement in cereal production has been observed in all districts over the period considered. The result of the FBS is attached as appendix A.

Moreover, to analyze whether the policy intervention carried out to ensure food availability impacts vary across the different districts, change in agricultural production between year 1999 and 2006 is computed and it is observed that all districts have shown increase in agricultural production in the year 2006 as compared to 1999 as it is shown in Figure 27 below. Thus, the before-and-after assessment on agricultural production shows that production has shown improvement in all districts since the introduction of the policy.

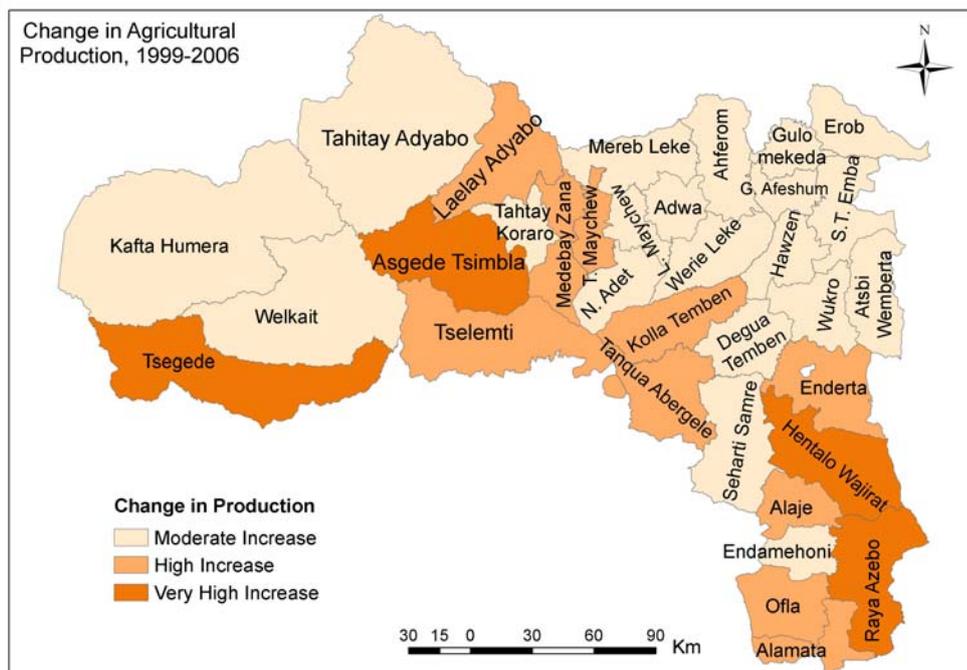


Figure 27 Spatial distribution of change in Agricultural Production, 1999-2006

**B) Per capita availability:** absolute domestic crop production has been revealed gradual growth over the period of program intervention. But is per capita food production also simultaneously increased in similar way? Per capita production of food is computed to assess the trends in population growth and crop production over the period 1997-2006. Accordingly, per capita cereal production has been found to decline from 243 kg in 1997 to 202.6kg in 2000 and has steadily increased to 257.4kg in 2006 as shown in Figure 28 below. Despite an increase in the year 2006, per capita cereal production has remained stagnant or declined during the period 2000- 2005 or per capita in 2005 was less than it was 8 years before. This shows that production has failed to keep with the fast growing population over the period 2000-2005.

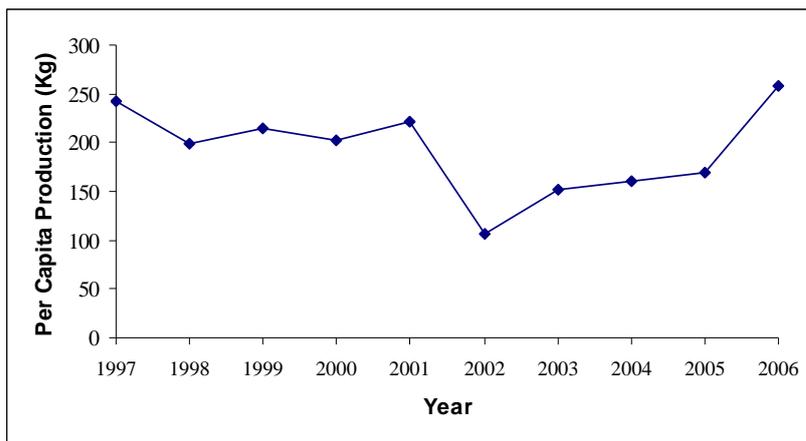


Figure 28 Trends in Per Capita Production, 1997-2006

### C) Economic growth

Economic growth is usually seen as a critical factor in reducing poverty and thereby reducing food insecurity. The structure and performance of the regional economy and its components can affect the food security situation of an entire region through the performance of food markets. Economic conditions can also create vulnerability and food insecurity if assets and incomes are distributed inequitably among the population, or if public and private sector investment is inadequate or skewed. The degree to which an economy is or is not diversified will often determine whether or not employment and income-generating opportunities exist that would provide sufficient purchasing power to meet basic food needs to all segments of the population. Also, the level of development and the dynamism of economic activities in rural areas often have a strong influence on the level of under-nourishment. Structure of regional economy and level of development in rural economy are the economic vulnerability factors that are assessed in this study, represented by share of agriculture in GDP.

Sustainable economic growth is an essential condition for poverty reduction in Tigray. In the early 1990s economic performance was extremely weak, with growth in GDP often less than the growth in population. Based on the data from Bureau of Finance and Economic Development, GDP grew at just -4.94 % in 1997, which given population growth of 2.7 % produced a negative per capita growth rate of -7.6%. Despite fluctuations, the regional economic performance has improved since 2003 and GDP growth rates averaged 12.1% between 2003 and 2006, or 9.4% per capita. Agricultural performance was very impressive and agricultural growth rates average 15.43 percent per annum over the period 1999-2007.

Moreover, in recent years it is observed that an impressive growth rate of GDP for the last four consecutive years (11%). It is argued that most of this impressive performance can be attributed to

policy changes and public investments, which boost total factor productivity and in general the economic reforms undertaken during the period, as much or more than reforms initiated under the Poverty reduction strategy.

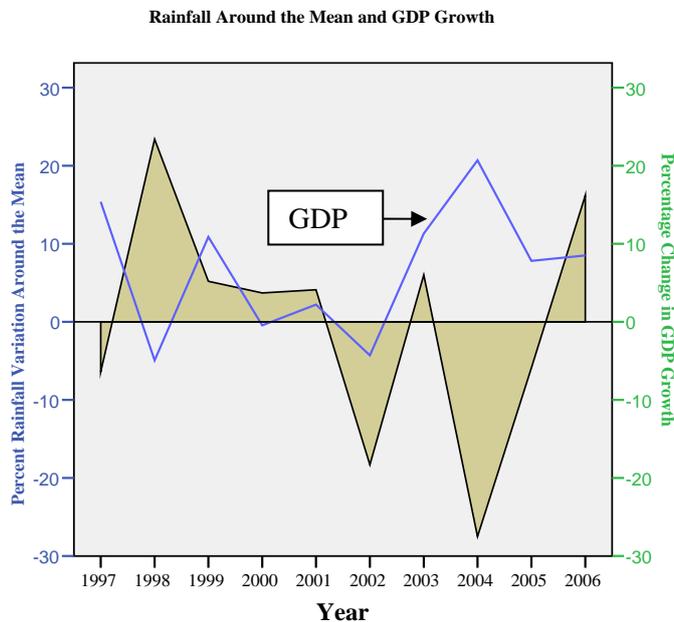


Figure 29 Rainfall Around the Mean and GDP Growth

Growth in agriculture is essential if rural incomes are to increase. However, structural change in the economy also requires that some other sectors grow faster still. Many key sectors have done so – manufacturing, construction, mining and quarrying and services have generally grown faster than agriculture since 1999. As a result, agriculture’s share of GDP has declined somewhat, from 53.6 per cent in 1999 to 49 percent in 2004.

#### **D) Drought/Disaster affected Population:**

The transitory food insecurity is aggravated by a sharp reduction in domestic supply of food because of crop failure or civil war. Crop failure and acute food shortages related to droughts have been frequently occurring in the region. Thus, what had been the exact situation in the region with regard to the population affected by chronic and transitory droughts over the period of time considered (1997-2006)?

Based on the before-and-after evaluation, it is observed that annual food grain production had been gradually increasing since 2000; and that the annual cereal production per capita had been starting to increase over a reported period of time. The graphical presentation in Figure 30 below is prepared based on data obtained from Disaster Prevention and Preparedness Commission. The peak proportion of drought affected population is registered in 1998 and 2000 with percentage of 34.4 and 52.1 respectively. What is important is the general trend which shows the fact that the situation is getting decreasing in terms of both the absolute and relative size of the population affected. Moreover, it is observed that the total amount of food aid supplied to the region over the period has decreased. This at least theoretically would mean that if maintained this trend sustainably, drought/food shortage could be mitigated at certain point in time.

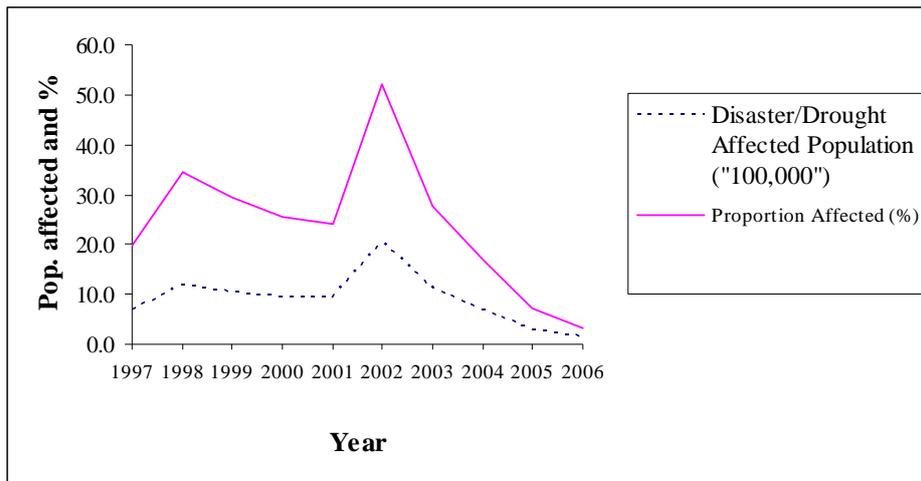


Figure 30 Drought/Disaster Affected Population and Proportion to total population, 1997-2006

Furthermore, the general trend on the spatial distribution of proportion of drought affected population across the different districts is analyzed based on the data obtained from the regional Disaster Prevention and Preparedness Commission. The graphical presentation in Figure 31 and Figure 32 below shows the spatial distribution of drought affected population in the years 2000 and 2005 respectively. As it is observed from the two figures the proportion of food insecure population per district in the year 2000 was very high as compared to 2005 and the peak proportion of drought affected population has dropped from 75.3 percent in the year 2000 to 44.6 percent in 2005. This declining trend is also complemented by the declining trend in the incoming food aid to the region over the period. Thus, it can be observed that the general trend shows that the proportion drought affected population has shown gradual decline. The spatial distribution of drought affected population in the year 2000 and 2005 is depicted in Figure 31 and Figure 32 below respectively.

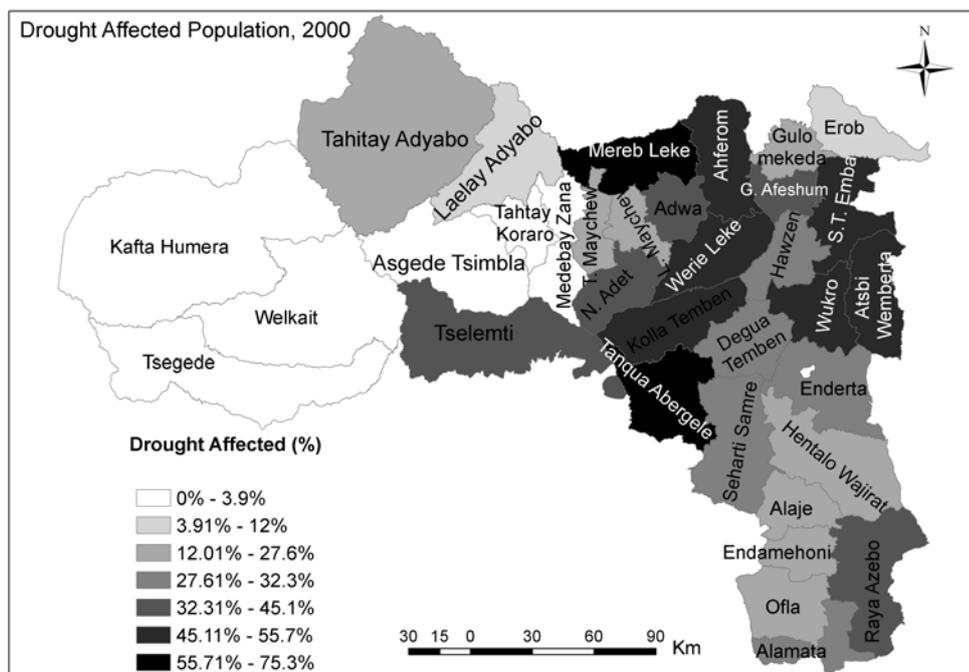


Figure 31 Spatial distribution of drought affected population in Tigray, 2000

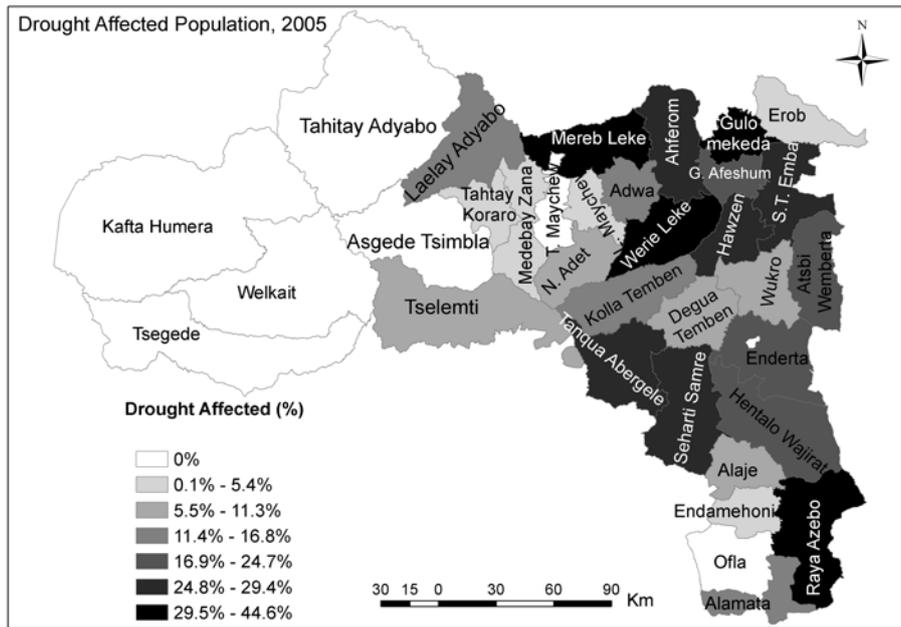


Figure 32 Spatial distribution of drought affected population in Tigray, 2005

The change in the spatial distribution of proportion drought affected population over the period shows that proportion of food insecure population has increased in 4 districts as it is shown in Figure 33 below. These districts particularly Laealy Adeayabo, Medebay Zana and Gulomekeda were affected by the border conflict with Eritrea and the farm households were displaced from their home. The border conflict had also left a large area of productive land unused because of landmines and this has affected the ability of households to farm. The increase on the proportion of food insecure population observed in these districts can be a good example of how the presence of armed conflict can be a source of food insecurity. Conversely, the rest 26 districts (86.7%) have shown a decline on the proportion of food insecure people since 2000. In general the before-and-after assessment revealed that the food security program impacts positive change across different districts as it is shown in the Figure 33 below.

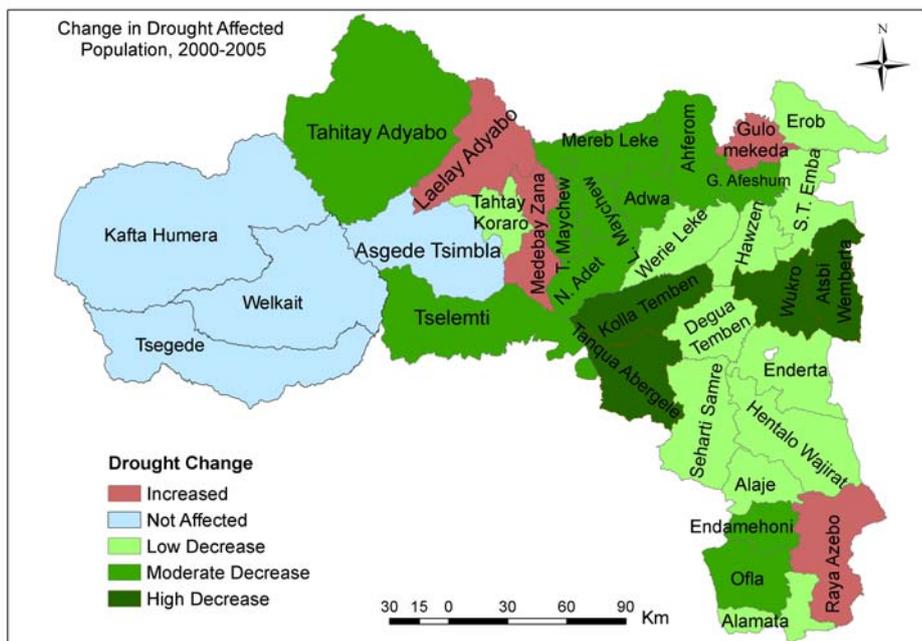
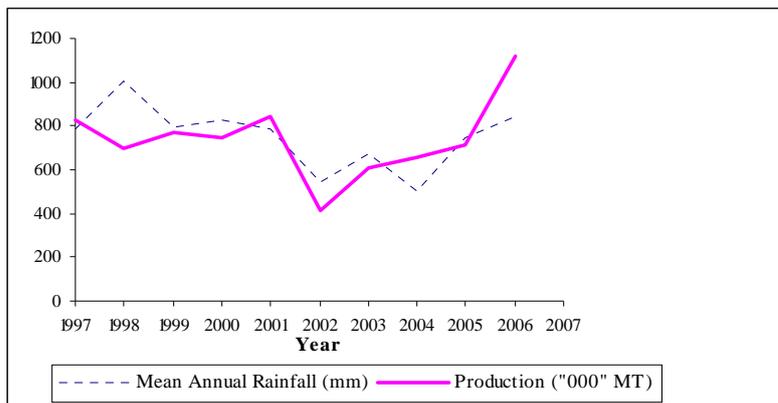


Figure 33 Spatial distribution of change in drought affected population in Tigray, 2000-2005

### 6.4.1. Effect of other Factors

It is observed from the above discussion that agricultural performance has been gradually increasing thereby contributing positively to food availability and food self sufficiency both at the regional and district level. One point worth to be looked at this stage is the effect of other factors on the impacts. Do all the changes observed in increasing food production explained by the effort made by the government or are there any contributing factors which have positive roles to the impacts? It is tried to check this question by taking rainfall as an exogenous variable and analysing its effect based on the rainfall data collected from National Metrological Agency.

As a result of its geographical location and topography, the spatial and temporal distribution of rainfall in the region has given rise to three main seasons. These are locally known as Kiremt (main rains), Belg (small rains), and Bega (dry season). Kiremt is the main rainy season in which about 85-95% of the food crop of the region is produced. Rainfall is the most climatic element that influences regional agriculture. The entire agricultural activity of the country in general and the region in particular is associated with the behaviour of rainfall. Food production is highly variable and unpredictable, mainly due to erratic weather. Thus, looking at the influence of rainfall and its contribution on the performance of agricultural production would be vital.



*Coefficient of correlation (r) = 0.54*

Figure 34 Rainfall and Production in Tigray.

Farmers are highly dependent on the climate for their livelihoods; this is reflected in the remarkable way that production fluctuations follow rainfall as indicated in Figure 34 above. Analyzing the relation between production and rainfall trends over the last 10 year, it is observed that they have positive relations with the coefficient of correlation 0.54. It is also observed that the trends in crop production over the decade and its growth instability in certain years indicate that crop agriculture is dependent on the blessing of nature and it is vulnerable to natural disasters and unpredictable climate behaviour. Von Braun (1991) similarly states that a 10% decline in rainfall below its long-term average reduces national food production by 4.4% cited in (Stephen Devereux 2000). Thus, it is revealed that besides the efforts made to increase agricultural production and productivity by the government rainfall has contributed positively to the performance of agriculture observed over the period.

In summary governmental figures shows that food availability and food self sufficiency ratio are gradually increasing over the period of 1997-2006. Besides food deficit is gradually decreasing both at regional and district level which are mainly attributed to the efforts exerted by the government. However, food supply indicator can provide some useful information regarding trends in food availability but they are often too aggregated to detect pockets of vulnerability in given area. Thus overall production or availability of food grain may be a bad indicator of what the vulnerable groups in the population can actually acquire.

Even when aggregate food supplies are adequate, a number of factors may prevent poor households or individuals from acquiring enough food. Income levels of the poor may be insufficient to enable them to purchase the necessary foods at the prices prevailing in the market. These households may also lack the necessary assets or access to credit to help them get through difficult times. Moreover, they may find themselves outside any public assistance or other program that would provide them with transfers in-kind or as cash to supplement their food acquisition capacity. Thus, looking on how people obtain access to food in relation to potential food availability and the government's intervention mechanisms undertaken to ensure access to food is important.

## **6.5. Interventions made to Ensure Access to Food and Impacts**

Lack of access is largely responsible for majority of the people going hungry everyday. This is primarily due to a lack of purchasing power. Increased incomes of the poor and ultimately ensuring sustainable livelihoods requires that their livelihood asset base be enhanced which includes physical capital (e.g. infrastructure), natural capital (e.g. water resources delivered through new infrastructure), human capital (through improved health and education), financial capital (through savings and credit programs); and social capital (through training and income earning activities that increase connections among people) (Amin and Farid 2005).

The national food security strategy states that the government should ensure access to food by addressing demand side (entitlement) problems. Based on the national food security framework, the regional government has been carried out different programs and projects to tackle the problems of rural households' access to food. These include measures to improve productive asset base and income of households such as measures to enhance off-farm employment and income generating schemes, credit services, improve food marketing systems, nutrition and health interventions, and education interventions. The different governmental interventions underway and their impact on ensuring sustainable households are discussed below:

### **A. Human capital**

Access to and utilization of education provides households the means to improve the household status socially and economically, as well as preparing people to exercise better decision-making that will directly affect the security of the household (IDA 2007). The failure to realize social benefits, such as the extension of health facilities and educational opportunities, also frustrate the incentive among the peasant population to change from subsistence to intensive agricultural production (Glantz 1987). The government has been made efforts to expand the human capabilities of rural households for the last decade. Thus, it is observed that human capabilities have substantially improved, albeit from extremely low levels. Starting from a low base, Tigray's enrolment expansion at all levels of education has been impressive, regional primary gross enrolment rate in grades 1-8 increased from 68.8 percent in 1999 to 104.1 percent in 2006. Female gross enrolment rate has also increased from 64.9% in 1997 to 103.8% in 2006. Moreover, governmental figures on education coverage shows that the number of schools and percentage of the school age population that is attending has dramatically increased over the past decade.

The absolute number of students and the proportion of female enrolments have been showing an increasing trend as it is depicted in Figure 35 below with out substantial gender and district differences during the period. This noticeable increase in female enrolment reveals government's commitment in gender equality in the long run. Maintaining this trend in the long run, the role of females as equal participant's in the future economic life of the region can be ascertained. Moreover, constant increment in school children attendant ratio in the region shows a lot of investment is made by the government on education which is the main indicator of human capital and one of the assets that play an important role in development. An encouraging sign in both gross and net primary and secondary

enrolment rates witnessed dramatic improvement over the period 1999-2006, especially in rural areas, and for girls more than boys.

Moreover, significant indication can also be observed from the trends in primary Gross Enrolment Rate (GER). GER declines in the year 2002 where severe drought has occurred all over the country in general. This indicates the fact that households are not able to send their children to school in times of drought which can be realized as the spiral effect of food insecurity on human capital.

Table 6 Trends in Primary GER

YEAR	MALE	FEMALE	TOTAL
1999	72.7	64.9	68.8
2000	85.2	76.9	81.1
2001	88.4	80.3	84.4
2002	81.4	75.9	78.7
2003	78.6	88.7	78.6
2004	88.2	100	88.5
2005	99.5	103.8	99.5
2006	104.3	103.8	104.1

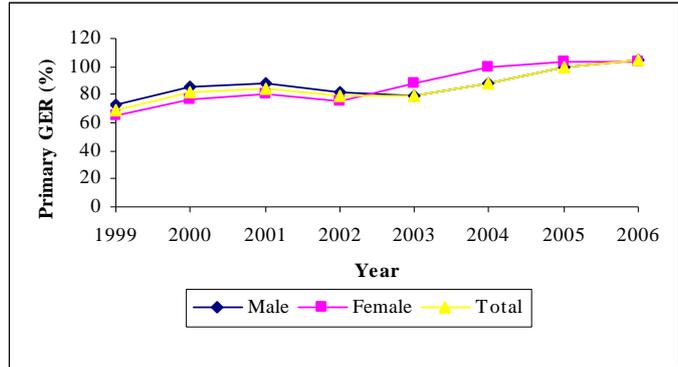


Figure 35 Trends in Primary Education Indicator

Furthermore, the general trend on the spatial distribution of Gross Enrolment Rate (GER) is analyzed based on the data obtained from the Bureau of Education. The graphical presentation depicted in Figure 36 Figure 37 below shows the spatial distribution GER in the years 2000 and 2005 respectively. As it is observed from the two figures, GER per district in the year 2006 has shown dramatic increase as compared to 1999 and the lowest GER has improved from 25 percent in the year 1999 to 68 percent in 2006. Furthermore, the proportion of female enrolment rates has been increasing in all districts over the period 1999-2006 and it is observed that the government’s policy intervention has brought a change in all districts. The spatial distribution of GER in the year 1999 and 2006 is represented in Figure 36 and Figure 37 below respectively.

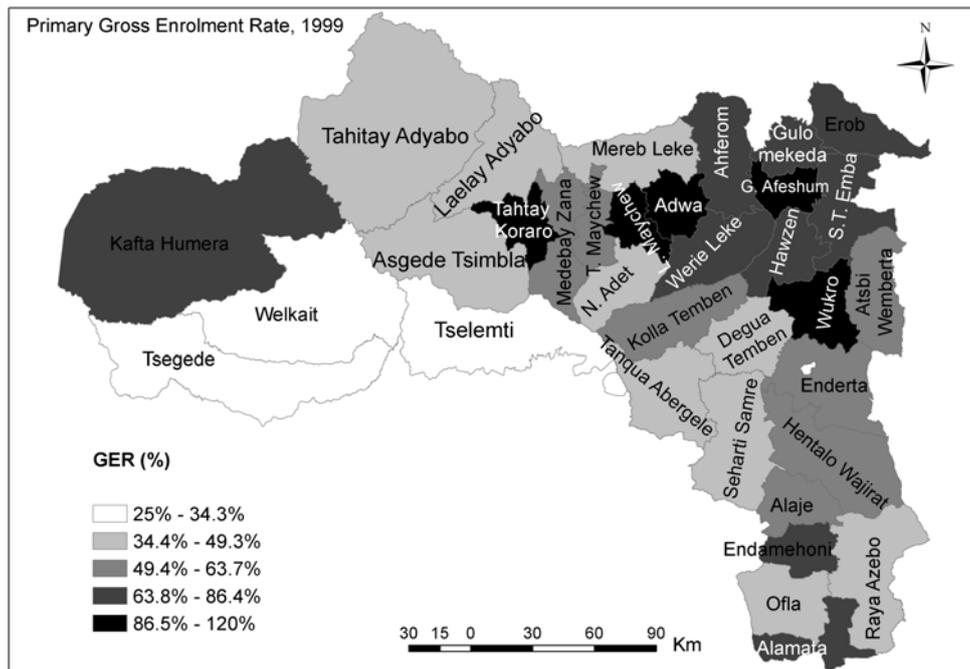


Figure 36 Primary GER per district, 1999

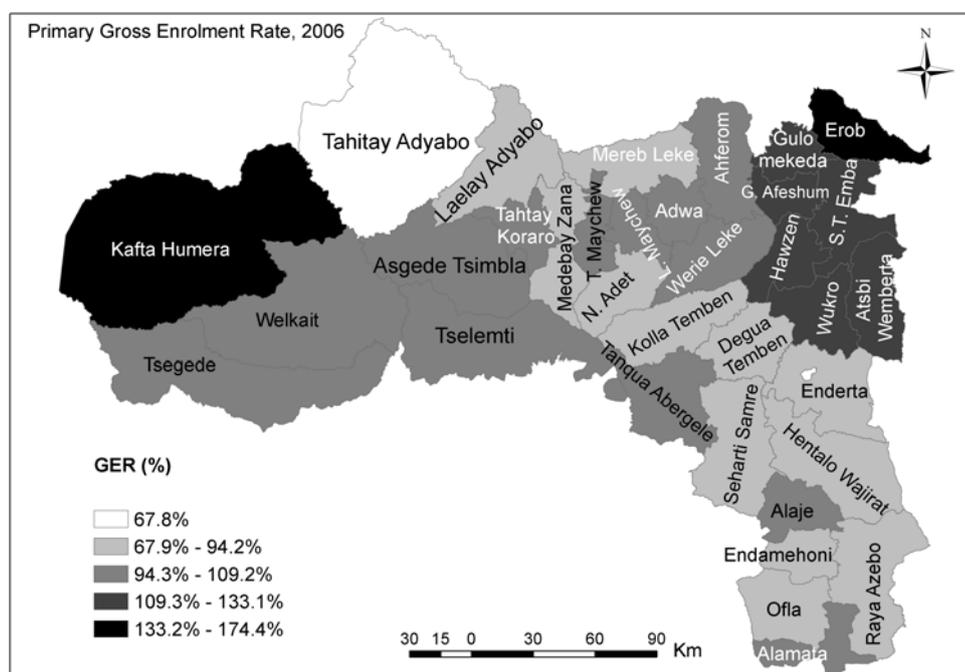


Figure 37 Primary GER per district, 2006

Furthermore, literacy rate in rural Tigray has been gradually increased from 18.83% in 1996 to 43.61 in 2004 [Table 7]. Adult literacy rates at 50% for males and 24.83% for females are considerably higher than the national averages in 2004 (at 43.43% for males and 18.66% for females). Comparing among urban and rural differential, illiteracy is considerably higher in rural areas (78%) than in urban areas (30%) and among women (67%) than among men (44%). The gains in rural literacy recorded during the periods were disproportionately captured by males.

Table 7 Trends in literacy in rural Tigray, 1996-2004

<i>Year</i>	<i>Male</i>	<i>Female</i>	<i>Both Sexes</i>	<i>Regional</i>
1996	28.20%	9.84%	18.83%	
1998	29.50%	10.20%	19.70%	
2000	30.60%	15.60%	22.50%	29.3%
2004	50.00%	24.83%	37.04%	43.6%

Source: Various WMS

Note: Literacy is defined as the percentage of Ethiopians aged 10 years and over who can read and write.

Despite some progress, child malnutrition rates in rural Tigray still remain extremely high imposing a substantial drag on the development of the next generation and future economic growth of the region. Different Welfare Monitoring Surveys undertaken indicate that chronic malnutrition (as measured by stunted growth) is coming down. The before-and after assessment revealed that both pre-school child stunting and severe stunting in 2004 have witnessed tremendous declines by 28% from the levels observed in the 1996 survey, indicating an improvement in the long-run measure of malnutrition. On the other hand, the figures for wasting (measure of short-term or acute under-nutrition) deteriorated over the same period as shown in **Table 8**.

Table 8 Children Malnutrition in Rural Tigray, 1996-2004

	<i>Stunting</i>		<i>Wasting</i>		<i>Underweight</i>	
	1996	2004	1996	2004	1996	2004
<b>Total</b>	<b>74.8%</b>	<b>46.88%</b>	<b>9.6%</b>	<b>12.18%</b>	<b>57.6%</b>	<b>42.47%</b>
<b>% Change</b>		<b>-28%</b>		<b>+26.9%</b>		<b>-26.3%</b>

It is also observed that health facilities have been improving in quantity and quality from time to time over the last ten years. Primary health coverage has reached 75 percent in 2006. Infant mortality dropped from 123 per 1,000-live birth to about 67 between 1996 and 2005. Similarly, Under-five child mortality dropped from 181 per 1,000 live births to about 103 during the same period, and life expectancy at birth has improved from 46 year to 52 year. These increases in life expectancy and the decreases in infant and child mortality in rural areas are remarkable. The health indicator figures indicate that a lot of interventions have been carried out to reverse the dismal situation of health condition by improving the health coverage and making health services accessible to the poor. Moreover, the rural population share with access to safe drinking water increased from 10.1 percent to 46 percent between 1996 and 2006. Despite the progress, over half of all households in rural areas still take drinking water from a source that is not safe.

It is also observed that the government is promoting adult training and it has recently substantially expanded the number of agricultural and health extension agents to strengthen the human capabilities of rural people. In a nutshell having with a vision of creating a new generation of farmers who can be instrumental for a rapid agricultural development, different efforts have been made to enhance the productive capacity of farmers and enable them improve their productivity through the provision of agricultural extension and advisory service on a continuous basis.

## **B. Natural and Physical capital**

The poor have limited assets in terms of land for farming and livestock. They also have limited access to different forms of economic infrastructure. Land is one of the natural rural resources on which an overwhelming proportion of the population in the region depend to make a living. Access to livelihood resource or capitals, such as land, where by households are able to own or access it has significant impact on household food security. With regard to this different institutional reforms have been carried out by the government to make land accessible to the poor. Concerning on the conditions to land access, it made it a citizen's right that any Ethiopian who wants to earn a living has the right to access land:

*'Ethiopian peasants have right to obtain land without payment and the protection against eviction from their possession'* (Proclamation No. 1/1995, Article 40, No.4).

The land redistribution program carried out was a positive step towards addressing the basic problem of rural households in the region. The process of redistribution of land has key effects on means of access to the poor. Moreover, certification of land ownership has been effective so that family rights in land are properly registered at the level of the districts administration. The regional government has also clearly stated that there will not be further land redistribution which also gives much security of tenure to the farmers. Ownership equality between both sexes is also enshrined in the land legislation. Women in the region enjoy equal land rights where a similar right does not apply in other parts of rural Ethiopia (except Amhara region). These are among the positive policy intervention implemented to address the problem of rural poor access to land.

However, it is observed that pressures on natural capital – the physical environment such as access to land appear to be increasing. Due to a rapidly rising population, a large proportion of each successive generation continues to require access to land in order to construct agricultural livelihoods. Land has been subdivided in order to allow later generations the ability to engage in agriculture. As this process occurs, the stresses on the agrarian structure continue to grow and holdings have also become spatially fragmented due to the cross-relationships of access that occur on marriage and death. Between 1997 and 2006 the regional population has increased from 3.3 to 4.3 million, while per capita landholding shrunk from 0.31 to 0.19 hectare which is below the minimum requirement to sustain production (see **Table 9** below). Thus, access and acquisition of resource is becoming difficult as population is rising.

Table 9 Population and Land holding in Tigray, 1997-2006

YEAR	POPULATION	LANDHOLDING PER CAPITA
1997	3,396,000	0.31
2000	3,694,700	0.26
2006	4,335,000	0.19

Source: BOFED

The regional government has responded to this situation by introducing resettlement program, and trying to take the pressure off some locations by relocating households to less densely and fertile places. However, these measures coupled with lack of control over land use management may cause environmental degradation and eco-system stress in the long run.

On the other hand, the regional government has carried out different intervention to empower rural households' access to physical infrastructure. It is observed that there has been substantial investment made in rural areas in physical infrastructure, especially roads. The total length of roads in the region was estimated to be about 4444 km in 2000, of which 1084 km was main road, 1360 km was rural road and the remaining 2000 km was community road. The total length of roads in the region has increased to about 9118.71km in 2006, of which 1309.45 is main road, 1549.718km is rural road and the remaining 6259.81km is community road. Excluding the community roads the road density of the region has increased from 33 km per 1000 square kilometre in 1997 to 51km per 1000 square kilometres in 2006. As it is depicted in **Table 10** the road density of the region has been growing at an average of 4.5% per annum. The before-and-after assessment on government interventions revealed that the rural poor has better access to physical infrastructures now than it was in 1997.

Table 10 Road density in km/1000km<sup>2</sup>, 1997-2006

1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	AVERAGE GROWTH RATE
33	35	36	39	39	43	45	47	50	51	4.5%

Source: Tigray Road Authority

As indicated above, community roads were built by the community through food-for-work projects which are aimed to link Tabia centres to the district capitals which has a significant role in the overall development process of the region by creating access to market and opportunity of getting inputs easily. The construction of roads has one of paramount importance in spatially linking the market centres with each other and with major centres. Currently 93.5 percent of the Tabia's are connected to all weather roads. Moreover, it is observed that access to physical infrastructure has shown gradual improvement in all districts over the period of 2000-2005. However, still 45.5 percent of the farmers are above 5km away from an all-weather road.

### **Input and output market system**

Lack of efficiently and effectively operating input and output market system is a major impediment to the development of regional agriculture and food production. As the region has varied agro-ecological and food production potential, a good amount of surplus food is produced in some parts of the region while there exists deficit in others. It has been experienced that due to weak transport and market links food cannot be sufficiently and easily transported to food deficit areas from surplus producing ones. The high transport cost and poor infrastructure networks aggravate the negative terms of trade for farmers when they earn much less for their produce against rising cost of production. Facing falling grain prices after harvest, farmers could not afford to purchase or take input credits and use it sustainably. Many studies have shown that poor infrastructure and dysfunctional markets prevent farmer's access thereby diminishing the profitability of agriculture.

The goal of improvement in food security calls for improvement in market policy and investment in infrastructure in order to reduce food transaction costs and enhance the incentive to produce more. Thus, different measures have been taken to address the problems of input and output marketing. Establishing cooperatives and expanding infrastructures are the major ones. In the past few years efforts have been carried out to organize and strengthen cooperatives. Accordingly, 489 multipurpose and 45 specialized cooperatives established and have started operation. The cooperatives had been involved in food grain marketing, consumer goods, agricultural tools and inputs delivery. Currently cooperatives are covering 65% of the total fertilizer supplied to the farmers all over the region.

Despite various efforts have been made to address the problems of economic infrastructures such as markets, still the issue of marketing infrastructure (lack of proper transport, storage, market information, communication ...) persists as a problem in the region. In particular marketing and demand side of agricultural development is the missing link to improve the production and food security of farmers in the region. Moreover, marketing infrastructure such as produce depots and storage is unavailable or not accessible to all farmers; and market information is inadequate and not readily accessible to producers.

### **C. Financial capital**

A critical factor behind destitution is lack of access to start-up capital, either in cash or in-kind, that would allow poor households to accumulate assets (especially livestock), or working capital to support informal income-generating activities which would enable them to invest in modern inputs or develop alternative income sources and improve their standard of living. Improving credit services will help to address both supply and demand side problems. The government has been given special assistance and support to rural finance, as they are important for rural development and for the creation of strong links between agricultural and other sectors, as well as for the development of a strong and efficient financial system.

It is observed that three main sources of credit are available to the rural farmers in the region. These are the Dedebit Credit and Saving Institution (DECSI), Cooperative Associations, and Women's Association. Out of the major suppliers of credit, Dedebit Credit and Saving Institution is the most popular in rural Tigray. This micro-finance institution has established in the regions to serve the farmers at the grass root level. It is said to be the largest micro-credit in Africa. Over the past years the institution advance credit and saving services to farmers with soft loans and the credit is available for agricultural inputs, household packages to poor farmers involved in crop and livestock activities, and micro and small enterprises. The output of credit facilities provided by Dedebit Credit and Saving Institution over the past years is summarized in **Table 11** below.

Table 11 Amount of credit disbursed and beneficiaries, 2001-2007

S/N	PARTICULARS	2001	2002	2003	2004	2005	2006
1	No. of Active loan clients	87,106	255,044	225,996	336,733	426,397	
2	Amount disbursed	8434316	10154225	16389373	22677840	25362475	294516398

Source: DECSI, reports

As it is shown in **Table 11** above the total number of loan clients has increased over the years. The package loans are provided to farmers in all districts of Tigray. A study conducted by DECSI on the economic impact of credit beneficiary of rural households in Tigray shows that 59% of clients improve the family's living standard, 57% increase their family's income, 51% increase family's asset and 49% increased their food quantity (Atakilti 2005).

It is also observed that the support DECSI is providing in terms of making money available to the needy has got appreciation from rural households. The credit and saving system provided by DECSI had enabled to generate employment opportunity by increasing the earning capacity of the poor. It also enables them to save earnings and builds up their capitals and assets. It is observed that the regional government has given due emphasis, among others, access to micro-credit as a means to empowering the poor to all factors of production by providing access to affordable credit and as one of the key element in reducing rural unemployment and reducing poverty.

However, the credit scheme of group lending as the sole type of service needs due consideration so as credit could be accessible at individual level and it should also have flexible entrance criteria, duration and interest rates suitable to rural households who have different needs and capabilities. In a nutshell, the government has carried out different efforts to make credit accessible to the rural poor and credit has been playing a vital role in supporting the production and incomes of vulnerable groups, and reduced rural families' dependence on drought prone districts through diversification of their income generating activities.

#### D. Safety Net Programs

Safety net programmes are intended to protect the poorest citizens in society or those who, as a result of a shock, find themselves temporarily below a given welfare level. Based on the national safety program, the regional government has adopted a safety net program with the purpose to help bridge the income gap of chronically food insecure households and to engage such households in community based asset building in exchange for the income they earn. The overall objective of the program is to improve the efficiency and productivity of transfers to food insecure households, reducing household vulnerability, improving resilience to shocks; and to provide multi-annual and predictable resource. The program has started in 2005 and has two components: labour intensive public works and direct support for labour-poor households. In line with these objectives different projects have been undertaken in the past three years to support the rural transformation process, encourage households to engage in production and investment, to promote the marketing development by increasing household purchasing power.

In 2005, the productive safety net program reached 0.9 million chronically food insecure people in rural areas, expanding to 1.4 million people in 2006. In 2006 the program generated many days of public works with a focus on rehabilitation of severely degraded areas and creation of productive community assets such as terracing, feeder roads, afforestation, and small-scale irrigation in the food insecure areas. The program enabled the move from emergency food towards cash transfers, with up to 905,359 beneficiaries receiving cash transfers in 2006 for their participation in the program.

While the overall direction looks promising, most of these strategies are in the early stages and cannot yet be evaluated in terms of how many people graduate out of food insecurity so far. But from the focus group discussion held with the target beneficiaries it is observed that the program is having a significant positive impact in improving the food security of beneficiaries and in helping to protect their assets. The safety net programs has enabled the poor to engage in livelihood strategies that offer the potential for pathways out of poverty, by providing risk mitigating opportunities and selecting community projects such as soil and water conservation activities that will enhance food production and reduce vulnerability to drought, thereby steadily reducing the numbers of people who are dependent on food aid. Moreover, it is observed that this program and investment in development projects has contributed in raising incomes of the poor and their capacity to acquire food through employment generating activities. Ehui and Pender (2003) found that food-for-work and cash-for-work projects accounted for 40% of non-farm income in Tigray (Holden, Shiferaw et al. 2004). Besides, food-for-work serves as an asset protection function during shocks by providing food transfer and thereby reducing the pressure to sell livestock.

The food-for-work implemented on public works is basically meant for community asset building including the rehabilitation of natural resources, soil and water conservation, construction of rural access roads and afforestation. This has ensured that appropriate community assets are constructed or renovated/rehabilitated thereby providing food insecure household's access to common resources and physical infrastructures. Hagos and Holden (2003) found a positive impact of food-for-work projects on private conservation investments in Tigray (Holden, Shiferaw et al. 2004).

An initial evaluation conducted two and half years after the start of the program by International Development Association revealed that the program is having a significant positive impact in improving the food security of beneficiaries, household asset creation, utilization of health service, and in community asset creation (IDA 2007). The evaluation findings revealed that three in five beneficiaries avoided having to sell assets to buy food in 2005 which is a common distress response to household food shortage, three in five beneficiaries retained more of their own food production to eat rather than selling it for other needs, approximately one quarter of program beneficiaries acquired new assets for their households, or new skills during 2005, half the beneficiaries surveyed stated that they used healthcare facilities more in 2006 than in 2004 and 76% of these households credited the safety net program with this enhanced access, more than one third of households enrolled more of their children in school and 80% of this was attributed to participation in the program, and the program has created substantial community assets in beneficiary communities, with economic and environmental impacts. All these changes are attributed to the productive safety net program.

In general promising experiences are emerging in the region where predictable safety nets, both food and cash based, are explicitly designed to promote the graduation of households out of chronic food insecurity; and most of the targeted food programs have shifted in emphasis from relief to development which is an important strategy in mitigating the effect of food aid dependency syndrome in the region. But in order to gain all the fruits of safety net programs, careful targeting of the program to the most needy should be given due emphasis in the region which was elicited as a problem during focus group discussions. Because leakage increases cost and reduces cost effectiveness of targeted interventions and the effectiveness of the program could be undermined by leakage and misappropriation.

## **E. Resettlement**

Over the past many years, a large portion of the region's population has been forced to depend on food aid for survival. These are the people who have lost the capacity to be productive mainly due to land degradation, drought and high population pressure. On the other hand, the region has a considerable

amount of land in the western part of the region currently under-utilized, but still suitable for farm activities. To rationalize the resource use and create the poor households access to productive resources such as land, the government has embarked upon voluntary resettlement program within region as one of its food security strategy.

According to the Disaster Prevention and Preparedness Commission Report, the region had resettled 32,847 people from 2003 up to 2005. Despite some problems encountered in the first year of its implementation, the resettlement program has proved as a reliable alternative to ensure food security in a very short period of time. Despite no assessment has undertaken, the focus group discussions held with key government informants revealed that the majority of the settlers have attained self-sufficiency in food and their livelihood has improved considerably. The program is also effective in providing households especially the youth and landless access to productive asset mainly land on which majority of the rural household depend for their subsistence. On the other hand, some expertise commented that resettlement is not proceeding as scheduled, needs better coordination and will take longer than expected. Lack of availability of social services is a few of the concerns elicited that hindered resettlement. Moreover, the focus group discussions held revealed that quite a large proportion of resettled farmers end up back where they started within a year or two of the resettlement.

## **6.6. Emergency Response**

Strengthening emergency capacity which includes early warning systems, disaster prevention and preparedness, and emergency food security reserve administration is the third pillar of the government's food security policy level objectives.

As elaborated in a range of policies, all citizens have a right to aid in times of crisis and it is the obligation and duty of government to respond. A key focus of the regional Disaster Prevention and Preparedness Commission (DPPC) early warning system is to prevent a repeated occurrence of the type of famines that struck the region in the 1970s and 1980s. Thus, information systems are critical for ensuring that government is able to uphold its responsibilities to the citizenry in an accountable fashion. However, it is observed that there is no information systems established to achieve the intended objectives. This task is left to the National DPPC where it has developed a fairly credible early warning system. Besides it is observed that the regional DPPC is poorly staffed which lacks the capacity to compile and collect information that comes from the district level, and context specific information appropriate to local agro-ecological environments and livelihood systems where by this information system can be used for disaster management systems.

In summary the government has been carried out different programs and projects to address the problems of rural households' access to food. These include measures to improve productive asset base and income of households such as measures to enhance off-farm employment. These measures aimed at promoting human capabilities of households have shown substantial improvement. A lot of investments in agricultural training centres have been made to strengthen the human capabilities of the rural people; and the number of agricultural and health agents have also substantially expanded over the past years. It is observed that different efforts have been made to enhance rural Poor's productive capacities through the provision of agricultural and advisory services on a continuous basis.

Furthermore, it is observed that interventions made to improve household's access to natural and physical capital were effective. Efforts have been made to improve household asset by providing poor households access to credit facilities. Besides the efforts exerted to improve households access to different forms of economic infrastructure such as access to all weather roads are effective. Productive safety net programs carried out in the past three years were also effective and it is observed that this program is playing a significant impact in improving the food security of the beneficiaries, household

and community asset creation. In general the before-and-after evaluation revealed that government interventions aimed at enhancing household's access to food are effective.

## **6.7. Conclusion**

The regional government has designed food security programs which are part and parcel of the poverty reduction strategy of the country. Since 2000 different activities have been carried out to ensure household food security that include agricultural extension services, water harvest and utilization, and resettlement programs which are called supply side actions designed to increase agricultural production and productivity. On the other hand different activities aimed at increasing incomes of the poor and enhancing their livelihood assets including physical capital, natural capital, human capital, financial capital and social capital have been carried out. These activities were targeted to improve the demand side of the food equation.

The government's food security interventions are effective solutions in mitigating the deep rooted problems of food insecurity in the region. Activities such as extension programs could be stated as a success intervention in most districts of the region. Safety net programs are playing a significant positive impact in improving the food security of beneficiaries, household asset creation, utilization of health service, and in community asset creation. Though it is not adequate, discussion forums were also created to accommodate the needs and aspirations of poor households during the formulation and implementation process of program interventions. Besides, it is observed that the infrastructure, skill enhancement, and agriculture/non-agricultural sector initiatives carried out is helping in bringing more positive impacts of food and non-food supported employment for infrastructure building, skill and training programs on the incomes of the poor.

However, there are issues that needs due attention. The price of agricultural inputs has increased over the year which is beyond the capacity of the farmers. Other intervention programs such as water harvesting were ineffective in some districts because farmers were not accepted on the technology. There were also signs that these programs were tried to implement through measure of coercive persuasion while households were voicing problems on the technology. Moreover, government interventions in strengthening the input and output market systems are not adequate to ensure sustainable attainment of food security at household level, and the government is not able to maintain price stabilization.

In summary based on the times series data collected from the governmental bodies, the food security program carried out has been achieving its intended objectives. The before-and-after assessments on the food security policy level indicators revealed there is change or sustained improvement on the main components of food security since the introduction of the policy. Accordingly it leads to a conclusion that government interventions carried out over the past seven year were effective in improving the lives of the poor. However, making overall concluding remarks on effectiveness of governmental programs by relying only on governmental figures and/or without considering the perception and opinions of the target beneficiaries on changes in their livelihood brought by the policy may lead to a subjective conclusion. Thus, validating the effectiveness of government's policy intervention on livelihoods of households based on the opinions and perceptions of policy beneficiaries is vital. This issue is discussed separately in chapter seven.

## 7. Food Security Determinants and Household's Opinion on Policy Intervention

One of the objectives of the study is to validate the effectiveness of government's policy intervention on food security status based on the opinions and perceptions of farm households in the Region. In order to attain this specific objective, household data were generated and analyzed through the assessment of farmer's perceptions and opinions on policy interventions; and to directly quantify the current food security status of households and to examine the kind of relationship that exists between food security status at current and the various factors influencing food security status at the household level.

To meet this objective primary data from sample household was collected from two drought prone districts. The two districts were chosen randomly from the food insecure districts of Southern and Eastern zones which are priority identified by the regional state. The survey gathered qualitative and quantitative data pertaining to social, demographic and economic aspects of households. The analysis is based on data from a sample of 90 households randomly selected. The sample units were chosen from the six tabia's using a random sampling method. Results and discussions of the studied households are discussed below.

### 7.1. Descriptive Results

This section provides the descriptive results of the studied households'.

#### 7.1.1. Land Holding Size and Its Dynamics

Land holding size is considered a critical production factor that determines the type of crops grown and the size of crop harvests. Moreover, availability of pastureland is an important issue for livestock rearing. Therefore, under subsistence agriculture, holding size is expected to play a significant role in influencing farm households' food security (Degefa 2002). In the survey, farmers' holding size was asked. The results are summarized in **Table 12** and **Table 13**.

On average, holding size per household was found to be 0.84 ha, which appears very small even when compared to the figures for the national average (0.95 ha) and for Tigray Region (0.97 ha) (CSA 1998). The holding size varied from 0.19 ha to 2.25 ha. Given the deteriorating and exhausted land conditions as well as backward agricultural practices, the average holding is generally smaller than the economic level necessary to adequately feed farm households in the study sites.

Table 12 Household land holding size (in Hectare)

		Frequency	Percent	Cumulative Percent
Valid	< .25	8	8.9	8.9
	.25 - .50	22	24.4	33.3
	.50 - .75	23	25.6	58.9
	.75 - 1.0	23	25.6	84.4
	1.0 and above	14	15.6	100.0
	Total	90	100.0	

SOURCE: Field survey, October 2007

**Table 12** present five categories of holding sizes and the proportion of farmers (sample respondents) that fall under each group and the total land occupied by the respective groups. About 33.3 percent of the respondents owned land holdings of 0.5 hectare or less, 25.6 percent owned land holding of 0.5 – 0.75 hectare. Less than 15% of the respondents had land holdings of greater than 1 ha.

Table 13 Percentage distribution of farmers, by farm size category and tabia

TABIA	NO. HH	FARM HOLDING SIZE				
		<=0.25	0.25-0.50	0.50-0.75	0.75-1.00	1 & above
Mayneberi	15	33.3	46.7	6.7	6.7	6.7
Hentalo	15	6.7	46.7	26.7	13.3	6.7
Ara Asegeda	15	13.3	13.3	20.0	26.7	26.7
Abrha Atsibha	15		26.7	33.3	46.0	
Kihen	15			26.7	20.0	53.3
Tsegereda	15		13.3	40.0	46.7	
Total	90	8.9	24.4	25.6	25.6	15.6

SOURCE: Field survey, October 2007

The variation in mean land holding was quite significant among the study tabias, with a range between 1.35 ha in Kihen and 0.51 ha in Mayneberi. The disparities at households' level appear considerably wider as is witnessed by the coefficient of variations given in **Table 14** and **Table 15**. Farmers in Kihen are relatively better off than their counterparts in other tabias in terms of size of holdings. In this tabia, over half of (53.3%) the sample farmers work on more than one hectare.

Table 14 Land Holding Size in the study sites

Type of household	N	Mean	Minimum	Maximum	Std. Deviation	C. V.
Male-headed	59	.8919	.25	2.00	.40767	45.4
Female-headed	31	.7399	.00	2.25	.47327	64.0
Total	90	.8396	.00	2.25	.43484	56.5

SOURCE: Field survey, October 2007

Table 15 Mean, maximum and minimum land holding size, by study tabia

TABIA	MEAN	MINIMUM (HA)	MAXIMUM (HA)	STD. DEV.	C.V.
Maynebri	0.5083	0.00	1.50	0.3613	71.1
Hentalo	0.6708	0.19	1.50	0.3191	47.6
Ara Asegeda	0.9000	0.25	1.50	0.4205	46.7
Abrha Atsebha	0.7750	0.38	1.00	0.2226	28.7
Kihen	1.3500	0.75	2.25	0.5240	38.8
Tsegereda	0.8333	0.50	1.00	0.1809	21.7
Total	0.8396	0.00	2.25	0.4348	56.5

SOURCE: Field survey, October 2007

### **7.1.1.1. Land Fragmentation**

Land fragmentation is a common landscape feature of Ethiopian agriculture. The causes of land fragmentation may be put under three main groups: socio-cultural and demographic causes (inheritance transfer, land reform, reallocation, etc.); economic causes (risk minimization, transfer through gift, sale or purchase, rental, share cropping); physical or environmental causes such as variations in climate, soil, etc.

The field survey data reveal a substantial variation with respect to the number of plots belonging to the studied farmers. The number of plots ranged between 1 and 4. Despite this wide gap, the overall average (1.21 plots) and cumulative frequency distributions suggest a low degree of land fragmentation in the study tabias. The relatively low degree of farm fragmentation among the farmers may be attributed, among the others, to two factors. First, the already small holdings of the farmers might have discouraged further land reallocation. Second, the regional constitution prohibits further land redistributions.

### **7.1.2. Agricultural Inputs and Extension**

Various studies have proved that appropriate application of modern farm inputs such as chemical fertilizers, improved seeds and herbicides can increase crop yield and productivity. Because of this fact, Ethiopian farmers have been for long encouraged to adopt utilization of modern farm inputs. The importance of these inputs becomes more significant in highly eroded soils and fragile environments to improve land productivity and to boost overall production. Therefore, utilizations of modern farm inputs are expected to enhance farm households' food security. The sample farmers were asked whether they utilize modern farm inputs to increase yields of their crops as is shown in Table 16.

#### **A. Chemical Fertilizers**

About 85.6 percent of the sample farmers reported to apply artificial fertilizers. The disparity between tabias in terms of adoption appears significant as the proportion varied between 100% in Abrha Atsibha to 60% in Kihen. Group discussion with farmers indicated that fertilizer application may not be economical and currently has much risk. As a result, the majority of farmers in Kihen tabia do not prefer the use of chemical fertilizers on their farms. Farmers prefer manure (compost) to chemical fertilizer because manure is less costly. Recent studies has also confirmed that manure (compost) improves the soil and water holding capacities of soils, which makes soils more resistant under drought conditions and reduces the vulnerability and riskiness of agricultural systems (Hartmann, H. Araya et al. 2007). Thus, farmer's preference should also be supported by government initiatives toward organic agriculture in the region.

#### **B. Improved Seeds**

The introduction of improved seeds that can withstand the problem of aridity and erratic rain distribution seems an important issue to the region under investigation. The field data shows that only 68.9% of the study farmers have adopted the utilization of improved seeds. The main constraints against applying this input among the farmers are limited supply and high prices. Thus, high cost of technical innovation is becoming a barrier to increased productivity among the low income farmers in the region.

Table 16 Participation of farmers in the application of modern farm inputs, by Tabia

Input	Maynebri		Hentalo		A/Asegeda		Abrha Atsibha		Kihen		Tsegereda		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Chemical Fertilizer	10	66.7	13	86.7	15	100.0	15	100.0	9	60.0	15	100.0	77	85.6
Improved Seed	8	53.3	9	60.0	13	86.7	13	86.7	9	60.0	10	66.7	62	68.9
Herbicides		0.0		0.0		0.0	9	60.0	2	13.3	4	26.7	15	16.7
Insecticides	5	33.3	7	46.7	7	46.7	4	26.7	2	13.3	0	0.0	25	27.8
Irrigation		0.0		0.0	14	93.3	14	93.3		0.0	6	40.0	34	37.8
Extension Services	10	66.7	13	86.7	15	100.0	15	100.0	11	73.3	15	100.0	79	87.8
Farm Credit	12	80.0	10	66.7	10	66.7	15	100.0	13	86.7	11	73.3	71	78.9

SOURCE: Field survey, October 2007

### C. Herbicides

Utilization of herbicides by the sample farmers was found to be low with only 16.7% reporting to have used them. Weeds are considered as an important source of feed for livestock, contributing to curbing out the shortage of pasture. As a result, the farmers are very much reluctant to use chemicals.

### D. Irrigation

The fact that the largest part of the region is characterized by semi-arid climate and with limited scope of transforming rain-fed agriculture, the magnitude of the demand for irrigation practice would clearly imply very high. The achievement so far, however, is not adequate as only 37.8% of the respondents were found to practice crop cultivation under small-scale irrigation. Moreover, the variation at tabia level is quite considerable. The percentage of farmers using irrigation in Abrha Atsibha was 93.3%. None of the samples in Maynebri, Hentalo and Kihen reported the use of irrigation.

### E. Farm Credit

The availability of agricultural credit to the subsistence farmers who have little or no capital or savings to invest in farming is an important component in small farm development programs. In line with this view, an attempt was made to know the number of farmers who had benefited from farm credit. Farmers mainly get credit from the Dedebit Credit and Saving Institution. The result provided in Table 16 shows that 79 percent of the studied households got access to farm credit. When associated with the degree of the production resource deprivation, the proportion seems very high. Asked about utilization of loan, most of the respondents answered that most of the money borrowed were invested on the purchase of livestock production, mainly for cattle, bee keeping, goats and sheep, purchase of an ox, or on the purchase of fertilizer and seed. Some farmers do not take loan because of the group lending system, which entails group responsibility for loan repayment. In addition, those who had taken loan, complained about the repayment time for settling the loan, which forces them to sell their grain immediately after the harvest when prices are at their cheapest. As far as the usefulness of the loan concerned, the respondents witnessed that except some loan management problems on the part of the borrowers, the loan has already brought some changes in their life particularly in asset creation and engaging in off-farm activities.

## **F. Extension Services**

In a country such as Ethiopia in general and Tigray Region in particular, where the majority of farmers are illiterate, agricultural extension would play a significant role in assisting them by identifying and analyzing their production problems and by making them aware of opportunities for improvement. Hence, the effectiveness of the other inputs in production partly relies upon the availability of sound agricultural extension services at community levels. The survey result revealed that 87.8 percent of the sample households identified themselves to be beneficiaries of extension services. The percentage of farmers using extension services is high at all tabias. Asked about the impact of extension, respondents witnessed that all beneficial changes in farming practice can be attributed directly to the extension services provided. Development agents are frontline workers in day-to-day contact with farmers. The survey finding revealed that development agents at the tabia level are playing a pivotal role in changing agricultural practices by transferring agricultural technologies to farmers through demonstration plots and trainings. Among the interviewed farmers, 73 percent expressed the view that development agents give advice in respect to new farming techniques. Conversely, it was emphasized that, faced with strong resistance from farmers (as with the issue of chemical fertilizer), then development agents at times apply measures of coercive persuasion.

### **7.1.3. Participation and Accountability**

The participation of poor households in the stages of policy formulation and its implementation, share control over development initiatives, and the decisions and resources that affect them is a pre-requisite for ensuring food security and for building a broad legitimacy of the process. Agricultural and rural development policies, programs, and projects must engage low-income people as active participants, not as passive recipients. To assure responsive policies, poor people need accountable organizations that articulate their interests. Thus, policy formulation should give due attention to the needs and aspirations of the poor, and voices of the poor need to be amplified by participatory processes. But participation should not be centred on encouraging local people to sell their labour in return for food, cash, or materials.

Participatory approaches have been used in the fields of governance and policy to enhance the accountability of state institutions and service providers to citizens and users. Mechanisms for securing accountability are particularly beneficial to the poor, given their relatively weak voice as voters or purchasers and users of services. Empowering the poor is also part of the broader agenda of sound governance and accountability of state institutions to their citizen. Thus, food security policies should need to address accountability to the poor by: ensuring at the formulation stage that the policy reflects the needs and priorities of the poor; ensuring during implementation that mechanisms are developed and enforced whereby the poor can contain corruption and hold government and service providers accountable for delivery of policies and goods; and building into the design of continuous monitoring by poor people for the fulfilment of the policy's commitments broadly.

The findings of the studied household survey revealed that 72 percent of the households have been participating in the planning and implementation processes of the development programs. It is also observed that there was widespread agreement across most of the respondents were nowadays more able to express their views and opinions freely than was the case five or ten years ago. However from the discussions made with governmental and non-governmental organisations, it is observed that at times the process of policy making did not allow new issues to be brought into the discussion forum by individuals or groups since all issues were framed by the government. Besides, there were no developed mechanisms that permitted non-state stakeholders particularly civil society organizations to continue participation in the monitoring and evaluation of the food security policy.

## 7.2. Household Food Security Status and its Determinants

Twelve explanatory variables were identified to be major determinants of food security in this study. These include household income, technology adoption, policy intervention, local leadership, land size, irrigation participation, type of household, age of household head, education level of household head, household participation in safety net program, and off-farm activity. All the factors were a priori expected to have a positive impact on food security status of households.

Fertilizer use was measured on the basis of whether or not a household uses fertilizer i.e. a dummy variable was used. A household that does not apply fertilizer took a value zero and a household that applies fertilizer took a value of one. The same applies to improved seeds.

Education is an additional factor which is thought to influence the food security status of households. Educational attainment by the household head could lead to awareness of the possible advantages of modernizing agriculture by means of technological inputs; enable them to read instructions on fertilizer packs and diversification of household incomes which, in turn, would enhance households' food supply (Najafi 2003). Educational attainment of a household head is considered by this study to be a qualitative variable. Households led by educated heads take a value of 1 while those who are led by uneducated heads take a value of 0.

Farmland size is a continuous variable. This study expected farmland size to affect food security status of households positively. According to Najafi (2003), food production can be increased extensively through expansion of areas under cultivation. Therefore, under subsistence agriculture, holding size is expected to play a significant role in influencing farm households' food security. The sample households plough fragmented plots with different sizes. The size of farmland owned by a household was determined by summing the fragmented plots, and converting it to hectares.

Age: the assumption here is the higher the age of the household head, the better the food security situation as there can be more options of making food available from both agricultural and non-farm opportunities. Hofferth (2003), in his study, argues that the higher the age of the household head, the more stable the economy of the farm household, because older people have also relatively richer experiences of the social and physical environments as well as greater experience of farming activities (Hofferth 2003).

Households diversify their incomes by working on farms as daily labourers, petty trade activities and by working as daily labourers on construction. Employment in off-farm and non-farm activities has a paramount significance to diversify the sources of farm households' livelihoods. It enables farmers to modernize their production by giving them opportunity to reduce the risks of food shortage during periods of unexpected crop failures. From this perspective, it is attempted that employment in off-farm activity is positively influences current households food security. In this study participation in off-farm and non-farm activities was measured by whether or not a household was engaged in those activities i.e. a dummy variable was used. A household who engaged in off-farm and non-farm activities took a value of one and households who did not engage in those activities took a value of zero.

Irrigation: the use of irrigation is a good strategy for promoting the crop production in the region. Thus, it is hypothesised that the use of irrigation positively influences household's food security status. A household who participated in irrigation activities took a value of one and households who did not engage in irrigation scheme took a value of zero.

Lack of appropriate development polices and responsive local leadership were one of the main factors which results vulnerability to disaster. Therefore, government policy and local leadership are expected to play a significant role in influencing farm households' food security. In this study these variables were measured by whether or not household perceive that government policy and local leadership do

brought change on their livelihood situation i.e. a dummy variable was used. A household who perceive change due to the policy took a value of one and households who did not perceive change due to policy or their local leadership took a value of zero.

### The model

As it is discussed in the research methodology part of section 3.5.2.1 a logit model has been estimated to elicit the factors influencing current food security status of households. The model uses current food security status of households as the dichotomous dependent variable. Current food security status variable is defined on the basis of shortfall of food availability and/or access to a household during a year. The logistic regression model employed to determine current food security status is:

$$\pi_i = E\left(Y = \frac{1}{X_i}\right) = \frac{1}{1 + e^{-(\beta_0 + \sum \beta_k \chi_{ik})}}$$

Where  $\pi_i$  = Probability that household is food secured,  $\beta_0$  = Constant term,  $\beta_k$  = Coefficients and  $\chi_k$  = For  $k = 1, 2, \dots, 12$  are the independent variables and subscript  $i$  denotes  $i^{\text{th}}$  observation.

$$\text{Let } Z_i = \beta_0 + \sum \beta_k \chi_{ik} \quad \text{Then } \pi_i = \frac{1}{1 + e^{-Z}}$$

As  $Z_i$  ranges from  $-\infty$  to  $+\infty$ ,  $\pi_i$  ranges from 0 to 1 and  $\pi_i$  is none linearly related to  $Z_i$ .

In estimated form, the model is,

$$L_i = \text{Ln}\left(\frac{\pi_i}{1 - \pi_i}\right) = Z_i = \beta_0 + \sum \beta_k \chi_k \quad \text{Where L is the logit. It shows the log odds in favour of}$$

current food security status changes as the respective independent variables changes by a unit.

The model is based on the following hypotheses.

- Current Food security status of households has no positive correlation with current income status, policy intervention, leadership, age of the household head, educational level of the household head, land holding size, package participation, employment in off-farm activity, type of household head and farm size.
- Availability of good policy is a supply factor influencing current food security status of households. Thus, it is hypothesized that the policy intervention did not bring change in the food security status of households or there is no association between current food security status of households and food security policy intervention.
- There is no difference in income between households covered by the program and those who do not covered.
- There is no association between current food security status of households and participation in irrigation scheme

### 7.2.1. Empirical results

In this section, results of the test for significance of the determinants of food security status of households and test of association between different variables and current food security status are discussed. The former was conducted using the likelihood ratio chi-square statistic and the Hosmer and Lemeshow test statistic was used to test the goodness-of-fit or predictive efficiency of the model.

Enter method was used for the analysis. The model was first checked when only the constant is included (i.e. all the predictor variables are omitted). The log-likelihood of the model was found to be 123.1 which is significant at 0.001. This represents the fit of the model when the most basic model is

fitted to the data. Overall the model classifies 56.7% of the households. The residual chi-square statistic is also found 46.9 which is significant at  $p < 0.0001$ . Thus, it can be observed that the coefficients for the variable not included in the model are significantly different from zero or the addition of one or more of these variables to the model will significantly affect its predictive efficiency of the model.

According to results shown in **Table 17** below, the log likelihood value of 58.04, with  $p < 0.001$  indicate that at least one of the parameters of the determinants of current food security status shown in the above equation is significant.

Table 17 Parameter estimates of the logistic regression

VARIABLE	B	S.E.	Wald	Sig.	Exp(B)
Constant	-22.371	40192.890	.000	1.000	.000
Farm Size	0.123	0.204	.362	.548	1.131
Fertilizer Use	-0.991	1.300	.581	.446	.371
Improve Seed Use	1.773	1.030	2.964	.085	5.887
Policy Intervention	3.294	1.185	7.722	.005	26.942
Local leadership	1.628	0.880	3.424	.064	5.093
Irrigation	0.993	0.834	1.418	.234	2.699
Male headed	-0.116	1.694	0.005	.945	.890
Age	-0.015	0.038	0.149	.699	.985
Read & Write	-0.615	0.862	0.509	.475	.541
Off-farm	0.153	0.819	0.035	.852	1.165
Current Income	0.006	0.002	6.438	.011	1.006
Safety net Package participation	0.209	1.074	0.038	.845	1.233
Percentage of correct prediction	0.867				
Hosmer & Lemeshow test statistic	13.524			0.001	
Log likelihood value	58.041			0.001	

Source: Computed based on survey data.

With regard to the predictive efficacy of the model, **Table 17** shows that, of the 90 sample households included in the model, 78 (86.7) are correctly predicted. According to the Hosmer and Lemeshow test statistic, a significant association exists between the observed and the model's prediction of a household's food security status.

#### 7.2.1.1. Parameter estimates of determinants of food security

According to results reported in **Table 17**, farm size is positively and significantly related to the probability of a household being food secure and it indicates that as the farm size of household increases the probability a household to be food secure also increases. This can be observed from the  $\text{Exp}(\beta)$ , which is the change that results from a unit change in farm size, is greater than one. However, the marginal effect of a unit change in farm land size, computed at sample mean of holding size, on the probability of current food security is 0.006. This means that the probability of food security increases by 0.6% for a one hectare increase in farm size which is not significant increase within the context of Tigray's situation.

According to the literature, subsistence farming, by its nature, is production for direct consumption. Any farm input that augments agricultural productivity is expected to boost the overall production. This contributes towards attaining household food security (Brown 2004). But the regression result shows a negative relationship between fertilizer usage and the probabilities of a household being food secure. This means that the likelihood of food security does not increase with farmers' use of fertilizer. Degefa has found similar findings that per capita food availability has declined for the farmers who utilized commercial fertilizers in Oromia Zone, Ethiopia (Degefa 2002). But the likelihood of

household food security increases with the use of improved seeds. As it is indicated in **Table 17** the current food security status of households who use improved seed are 6 times food secure than those households who do not use improved seed. It is also observed from the findings that the probability of a household to be food secured increases with access to irrigation activities that is those households who have access to irrigation scheme are 3 times more food secure than those who do not have access. Similarly the regression result shows the likelihood of current food security status declines with age of household. This means the probability of current food security status decreases with an increase in the age of the studied household heads.

The regression result also shows current food security status of household's increases with female headed households in the study area. This result may be explained by the work discipline and saving culture of female headed households. Women in the region are constitutionally empowered to access to productive assets such as land. Development programs enabled women to use and benefit from their own resources and capabilities. These programs include the Tigray Women Association provide women with opportunities to develop social networks and undertake collective or substitute for their lack of physical and financial assets. These female borrowing groups through micro-credit programs in the region have contributed to women's empowerment at the household and community level, while also increasing household's income and well-being. Similar research confirms that agricultural productivity increases dramatically when woman get the same amount of inputs as men. When female African farmers obtain the same level of experience and access to services that currently benefit male farmers, they increase their yield by 22 percent (IFPRI 2000). Thus, evidence shows that enhancing women's control of resources directly contributes to improvement in household food security which is inline with the regression result.

Government policy failures are the other responsible factors for the recurrence of food shortage or poverty and underdevelopment in Ethiopia. Lack of appropriate development policies and strategies were one of the main factors which results vulnerability to disaster. In light of this idea government policy intervention was one of the variables in the model. The logistic regression shows that government policy intervention has a positive influence on the current food security status of households. This means that the likelihood of households' food security with government food security program intervention is 27 times higher to be food secure than those households without the program interventions.

The regression result also shows there is a positive influence between current food security status of studied households and local leadership factor. This means the likelihood of food security is influenced by the local leadership at tabia level where all the poverty oriented developmental programs are carried out. That is those tabia's with good and participatory local leadership are 5 times higher to be food secure than those with un-participatory local leadership. Thus the region's effort in ensuring food security is influenced by local leadership factor. During the field visit it is observed that difference in local leadership is resulting variation in the livelihood of households among the studied tabia's. The Tabia with committed and participatory local leadership in Abrha Atsibha has brought a change on the livelihoods of households than Mayneberi tabia where the studied households thought that the local leadership is not participatory.

Finally, a forward step wise method of analysis is also employed for the analysis to investigate the most significant variables. As it is shown **Table 18** the variables are reduced to four. This result also shows government policy intervention significantly contribute to household food security.

Table 18 Parameter estimates of the logistic regression, Forward Stepwise method

VARIABLE	B	S.E.	Wald	Sig.	Exp(B)
Farm Size	-.633	.314	4.058	.044	.531
Current Income	.003	.001	12.470	.000	1.003
Policy Intervention	4.068	2.423	2.819	.053	58.423
Off-farm	-2.220	1.168	3.613	.047	.109
Constant	-12.457	4.171	8.920	.003	.000

Source: Computed based on survey data.

### 7.2.1.2. TEST OF ASSOCIATION

The sample households were asked about their opinions on the measures taken by government and change in their livelihoods. Thus, a hypothesis that government policy intervention and current change in the food security status of households are independent or there is no association between current food security status of households and food security policy intervention. To test this hypothesis Chi square test statistic is used. Spearman's Test which is one of the chi-square test used for categorical variables (counts) is calculated to test the association of the two variables.

Table 19 Chi-Square test between food security status and policy

		Food security status now		Total
		Insecure	Secure	
Do respondents thought the measures taken by government have brought about changes in their food security status	No	23	1	24
	Yes	16	50	66
Total		39	51	90

Spearman's rho = 0.6389 Prob > |t| = 0.0000

The Chi-square test result, Spearman's rho = 0.6389, indicated in **Table 19** above shows that the change in food security status of households and the policy measures taken by the government are strongly correlated at 95% percent confidence level. Since, the P-value is much lower than the critical significant value of 0.05. Thus, it can be concluded that government policy interventions has brought change on the current food security status of households.

Most government social programs are targeted to a specific group of the population. Within that group some individuals, households or communities get the program and others do not depending on budget constraints, implementation capacity and targeting efficiency. Thus, constructing counterfactual is central to establishing impact, the importance of the factual – what actually happened. To analyze how the intervention has played out on the ground, collecting data from both affected by the intervention (the treatment group) and those who have not been treated (the comparison group) was necessary. Thus, data from safety net program beneficiaries and those who use small scale irrigation scheme to supplement their farming is collected to shed the light on the findings.

To investigate the impact of safety net program on the livelihoods of households, test for equality of mean of income between households included in the program and those who have not included was employed. A null hypothesis that there is no difference in the mean income of households included in safety program and those not included against the alternative hypothesis that there is a difference in

mean income between the two groups of households at 5% significance level. The mean summary statistics of households is indicated in **Table 20** below.

Table 20 Mean summary income of households

Household included in the package	Mean	Minimum	Maximum	Std. Deviation
No	3860.50	1900	9620	1955.937
Yes	7984.00	1680	41860	7588.805
Total	7067.67	1680	41860	6959.668

To test the formulated hypothesis, relevant test statistic was first verified by looking at the test of normality of mean income distribution of households. The mean income distribution of both groups is found to be significantly deviate from normal. Thus, the non parametric, distribution free, test called Mann-Whitney U test which is the most commonly used is employed in the study.

Table 21 Test for equality of mean of HHs included and not included in Safety net program

	Estimated annual total household income now
Mann-Whitney U	363.500
Z	-3.266
Asymptotic Sig. (2-tailed)	.001

According to the non parametric result asymptotic significance (2-tailed) is 0.001 which is much lower than the P-value 0.05. Thus, we reject the null hypothesis there is no difference in the mean income of both groups. Moreover it can be revealed from the summary statistics that households treated by safety net program have a higher income than those households who have not been treated by safety net program intervention. This counterfactual test substantiates the above test of association between government policy intervention and change in the livelihood status of households.

Water harvesting is regarded as the main pillar of national food security strategy in the region. It is also considered as the single most important means to increase agricultural productivity and address the problems of water shortage in the drought prone areas of Tigray. Thus, different interventions have been undertaken to utilize the available water resource for agricultural purposes and secure households particularly in moisture deficit areas of the region. To analyze the impact of these interventions two ways of counterfactual test is employed. The first is to test whether there is any association between current food security status of households and interventions on irrigation scheme and the second is to test whether there is a difference in the mean income of households who have been benefited from irrigation scheme and those households who have not benefited.

To look at the association of government intervention on irrigation and current household's food security status Chi-square test was used. According to **Table 22** below the Spearman's rho is found to be 0.433 which is significant at 5% level of significance. Thus, we can observe that there is a significant association between household's current food security status and Irrigation activity.

Table 22 Chi square test of between food security status and Irrigation activities

		Food security status now		Total
		Insecure	Secured	
Do households participated in irrigation project	No	34	23	57
	Yes	5	28	33
Total		39	51	90

Spearman's rho = 0.4327 Prob > |t| = 0.0000

To analyze the impact of intervention activity on the livelihoods of the households, test for equality of mean of income between households participated in irrigation scheme and those who have not participated is employed. A null hypothesis that there is no difference in the mean income of households participated in irrigation activities and those who have not been participated against the alternative hypothesis that there is a difference in mean income at 5% significance level.

To test the formulated hypothesis, non parametric called Mann-Whitney U test is used. According to the non parametric result indicated in **Table 23** below, asymptotic significance (2-tailed) is 0.000 which is much lower than the P-value 0.05. Thus, we reject the null hypothesis that there is no difference in the mean income of both groups. This counterfactual test shows that those who have been participated in irrigation scheme have higher mean annual income than those who have not access to irrigation activity. This test further reveals that government interventions on water harvesting activities has been created household's an opportunity to supplement the rain fed agriculture and use it for vegetable and fruit production in their garden and thereby lead to higher income.

Table 23 Test for equality of mean of HHs with access to irrigation scheme and without

	Estimated annual total household income now
Mann-Whitney U	213.500
Z	-6.087
Asymp. Sig. (2-tailed)	.000

### 7.3. Conclusion

The findings of the regression model show that government policy intervention and local leadership significantly contributes significantly to the household's food security status. It is also found that there is a strong association between government policy interventions and current food security status of the studied households and the studied households perceive that the government interventions carried out over the past periods have brought change on their livelihoods. Moreover, the findings of the regression revealed that households covered by food security program components have higher income and better food security status than those households who have not been treated or covered by the programs.

## 8. Conclusion and Recommendations

### 8.1. Conclusions

Achieving food security is among the most significant development challenges facing Ethiopia. In fact, many would say it is the most urgent task facing the country today. Achieving sustainable food security requires a complex of public and private actions. It implies reaching a number of development goals, including stimulating agricultural production, expanding livelihood opportunities, increasing incomes, and improving nutrition directly at household level. Currently food security had become virtually synonymous with development.

This study reviewed food security policy effectiveness in Tigray regional government. Concepts and theories of food security helped to get the broader picture of food shortage causations while sustainable livelihood framework helped to understand the general picture of households. Before-and-after evaluation designs is employed to evaluate the impact of government interventions on improving the lives of the poor (policy effectiveness), and interface concepts of the sustainable livelihoods framework approach. Food security policy level indicators such as availability of adequate food, access to food, and utilization of food supplies were considered to assess the change in food security situation. The main findings of the research are summarized below.

**There are diverse and interrelated causes for household food insecurity:** The underlying factors for household food insecurity can be grouped in three main types as natural, socio-economic factors and policy failures. Natural resource degradation, recurrent drought and environmental degradation are important natural factors that make households vulnerable to food shortages.

Social factors such as population pressure, traditional farming system and practices, and economic limitations like poor infrastructural services, shortage of farm land and other productive assets are also factors responsible for household's food insecurity in the region. Poor infrastructural services such as poor marketing, rural transport and communications are the main constraints to achieve household food security. In general a combination of short-term and long-term factors explains the increasing food insecurity caseload in the region. Long-term factors, such as the interaction between environment, and high population growth, and diminishing land-holdings lead to significant decline in productivity per household. These trends have combined the repeated effects of drought over the years, to substantially erode the productive assets of communities and households.

Above all, past governments' misguided economic policies were the main factors for exacerbating food insecurity in the region. Decade's long civil war in the region is also the main factor aggravating food insecurity in the region.

**Spatial clustering of food insecurity exist in the region:** Based on the proportion food insecurity among the districts it is found that there exists strong spatial clustering of food insecurity among the districts. Moreover factors such as land holding, per capita production and rainfall matter for the spatial clustering food insecurity. The results of the research have confirmed that there is a strong and significant spatial dependency among the food insecure districts.

**Effective interventions have been made to address supply side problems:** The evaluation study findings revealed that considerable progress is being made through out Tigray in delivering improved services to the farmers. In rural Tigray, agricultural extension services appear to be improving quit fast and the extension programs have increased in terms of the number of participants and services rendered. The extension programs have been found successful in augmenting agricultural production and thereby increasing incomes of the poor. The findings of this research further indicate that the

government has recognized the economic value of water and water harvesting schemes has been proved to be effective and useful in enduring household food security; and it is the most important means to increase agricultural productivity and to avert the recurrent erratic rainfall and dry spell condition which often result in crop failures in Tigray.

**Agricultural and per capita production has increased:** Domestic food production is the major source of food supply and fluctuations in production are a major cause of instability in food availability. The results of the study revealed that the regional grain production is growing annually at an average of 10.8 percent after the introduction of policy. Regional level food security assessment using the Food Balance Sheet for a period of 2000-2006 shows that the food availability gap or food deficit has declined by 8.4 percent. The regional food availability and Self Sufficiency Ratio has increased by 8.1 and 9.1 percent respectively. Similarly the findings of the Food Balance Sheet computed for all the districts revealed that improvement in food availability ratio has been observed in 95% the districts. Moreover, the before-and-after assessment revealed that agricultural production has shown improvement in all districts since the introduction of the policy. Thus, it is observed that the policy intervention impacts significant changes across districts.

**Drought/Disaster affected population has decreased:** It is observed that the regional level food security assessment using the food balance sheet as an indicator shows that food availability gap has declined. The single most important indicator of this fact is the declining flow of food aid to the region for the period 1997-2006. Furthermore, the general trend on the spatial distribution of proportion of drought affected population across the different districts has also shown gradual decline over the period of 1997-2006. This shows the fact that the situation is getting better and better.

**Effective interventions have been carried out to address demand side actions:** Different interventions have been carried out to increase incomes of the poor and enhance the livelihood resource of households which includes the physical capital, natural capital, human capital and financial capital of the poor. Effective measures were taken to provide the poor access to land where majority depend for their subsistence. In addition, rural women have given equal right of access to ownership and control of land. Efforts to improve the livelihoods of rural people, the poor and women in acquiring 'human assets', especially health and education, are effective as well as just. Roads have been improving, reducing the isolation of rural areas and making for better connection between towns for transport, exchange and market development.

Measures carried out to provide household's access to credit facilities are effective. Availability of credit has improved through micro-finance institutions and cooperatives that were established to serve the farmers at the grass root level. Thus, it is observed that credit has been made accessible to the poor households and this had helped them to accumulate assets and as a working capital to engage in informal income-generating activities such as petty trade and animal fattening.

Safety net program is one of the government's intervention carried out to ensure food security at household level. The study findings reveal that safety net program has positive impact in improving the food security situations of the beneficiaries, household asset creation, utilization of health service, and in community asset creation. These programs and investment in development projects has contributed in raising incomes of the poor and their capacity to acquire food through employment generating activities. Besides most of the targeted food programs have shifted in emphasis from relief to development which is an important strategy in mitigating the effect of food aid dependency syndrome in the region.

**Farmers participate in development agenda and technology transfer:** A persistent failure in the history of rural and agricultural development in Ethiopia is the inability to transmit better development

ideas, technology and practices to farmers in participatory and accountable ways. It is observed that over the past years many development agendas, food security programs and practices of high social benefit were designed with the participation of the rural people and farmers. The study findings reveal that different discussion forums were organized to accommodate the needs and aspiration of the poor during the policy making process. The poor had been given the chance to ask “why”, “where”, “how” and “when” to practice, adopt, and use the different agricultural technologies introduced given their circumstances. Moreover, significant efforts were also made to increase the number of capable and responsible development agents who are mandated to teach farmers at grassroots level.

**Integration of Environmental Objectives:** The food security programs carried out were not only aimed at improving the economic and social condition of the poor but also these programs have been integrated with environmental objectives to mitigate the environmental degradation. Different community support activities aimed at developing the agro-economic infrastructure which are necessary to combat the challenges of drought have been carried out over the past periods. A vast area of land is covered with soil and water conservation to rehabilitate the degraded land. Safety net programs particular the food-for-work component is integrated with community asset building particularly with the rehabilitation of natural resources, and soil and water conservation. It is also observed that participatory forest management was introduced so that forests are protected with bylaws that have been agreed upon by communities and participation of local people in the management and rehabilitation of common resources. However, it is also observed that the environmental implications of promotion of fertilization of farm land as an objective to augment agricultural production is not explicitly assessed.

**Interventions lack integration with population policy:** Policies that allow poor people to achieve economic security are the best way to assure that birth rates will decline. The government has initiated some bold measures that would change the lives of the poor, such as agricultural policy, poverty reduction strategy, and the food security. However, none of these policies focus on population, despite its causal role. Due attention is not given to issues of population and the government has failed to commit to and implement its population policy. Thus it observed that pressures on natural capital – the physical environment such as access to land appear to be increasing and thus land holding per capita has declined over the period 1997-2006.

**Rainfall has played a contributing factor for improving agricultural performance:** The study findings revealed that agriculture has been gradually increasing thereby contributing positively to increasing food availability and food self sufficiency both at regional and district level. Results of the finding also revealed that food production and rainfall have positive correlation. Thus, it is revealed that rain fall is the main external factor which has contributed positively to the observed improvement in food production.

**Policy and local leadership influence household food security:** The findings of the household survey result shows that government policy intervention and local leadership significantly contribute to the food security status of studied households. It is also found that there is a strong association between government policy interventions and current food security status of households and households perceive that government interventions carried out over the past periods have brought change on their livelihoods.

**Households targeted by food security program are more food secure:** The findings of household survey revealed that households covered by food security programs have higher income and better food security status than those households who have not been treated or covered by the programs.

In general considerable progress has been made throughout Tigray in improving the livelihoods of the rural poor. The before-and-after evaluation revealed that the activities carried out have succeeded to

bring change on the main food security policy level indicators such food availability and food access across all districts. The overall findings of the research show that government interventions carried out since 2000 has been achieving its intended objectives and are effective in improving the lives of the poor and thereby addressing food insecurity.

## 8.2. Recommendations

In order to improve the households' food security in the region, the following may be the major areas of intervention.

**Efforts should be made to develop medium and small scale irrigation schemes:** To better manage available water resources for agricultural development and food security, the regional government should commit to increasing significantly the total agricultural area under irrigation and these activities should consider the negative impacts on the ecosystem. This would require the provision of loans, and technical assistance to small-scale irrigation systems managed by local communities, as well as the development of selected large-scale irrigation projects where appropriate. This should take due consideration the negative impacts of these projects on the environment and the ecosystem in general. Moreover, the objective of augmenting agricultural production should also be complemented by government's initiative towards organic agriculture in the region.

**Enhance the performance of domestic markets:** problems such as the lack of market information and the absence of market intermediaries will need to be addressed. On the input-market side, the capacity of local suppliers of credit, improved seed, etc. would need to be strengthened, with a view to establishing dependable marketing links between suppliers of inputs and farmers, based on sound small business management, reliable supplies of inputs, and financial sustainability. Overall, special attention should be paid to putting in place institutional, legal and financial frameworks that promote private investment in agribusiness and agro-industrial enterprises, with emphasis on small-scale industries that are capable of diversifying food and agricultural products, supplying effectively agricultural inputs, and providing basic transport and marketing services. In addition, the development of strong and effective market information systems should be promoted.

**Measures against the prevailing high population growth are also possible:** The regional government should seek ways and options through which the land carrying capacity and population size would be balanced. The rapid population growth should receive a special consideration and the national population policy has to be effectively implemented in the region.

**Enhancing saving habits:** bringing attitudinal change in terms of improved saving habit of farm households should be emphasized as one of the intervention measures. Improving saving habit of rural households should be considered as one aspect of the extension package for farmers.

**Problems of insufficient farmlands should be relaxed:** Promoting off-farm and non-farm employment opportunities, through which some proportion of the farmers could shift from direct reliance on land for their livelihoods. This can be materialized only if the farmers' problem regarding shortages of cash income could be overcome. Therefore, enhancing rural credits to the subsistence farmers would be vital.

The success and effectiveness of the suggested interventions towards improving the households' food security will be partly based on the collaborative and integrated efforts of the different development actors, namely, the government, NGOs and private investors. Therefore, enhancing networks and information exchanges among these actors may help in the planning and implementation of appropriate development activities. Otherwise, resources may be wasted by duplicating similar interventions whereby other constraints would remain without receiving the necessary attention.

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## Appendix A- Food Balance Sheet Computed for all Districts, 2000-2006

S/N	District	Growth rate			
		Cereal Production	Food Balance Sheet	Self Sufficiency Ratio (SSR)	Food Availability Ratio (FAR)
1	Adwa	164	11.1	154.6	25
2	Ahferom	82.82	7.4	77.8	3.2
3	Alaje	146.1	-9.4	112.9	39
4	Alamata	20.8	-64.8	13.4	1.9
5	Asegede Tsimbla	16.2	10.9	14.2	15.2
6	Atsbi Womberta	47.8	13.2	46.7	6.1
7	Degua Temben	16	5.3	13.5	2.5
8	Endamehoni	37	17.4	29.8	8.7
9	Enderta	56.1	13.5	46.3	21.1
10	Erob	18.7	5.3	29.2	16.3
11	Ganta Afeshum	47.4	22.7	45.6	3.5
12	Gulomekeda	67.6	12.1	68.3	17.9
13	Hawezen	42.4	1.5	54	18.9
14	Hintalo Wajerat	39.7	24.8	41.3	24.2
15	Kafta Humera *				
16	Kilte Awelaelo	67.9	19.6	66.7	11.2
17	Kola Temben	19.5	8.1	16.6	3.2
18	Laelay Adiyabo	30.5	20	27.4	28
19	Laelay Maichew	7.1	20	0	-4.8
20	Medebay Zana	14	-1.5	11.6	8.8
21	Merebleke	211.1	11.2	202.7	33.2
22	Naeder Adet	7.24	5.41	6.1	-1.8
23	Ofla	11	94.7	12.5	8.7
24	Raya Azebo	137.8	-40	143.2	160
25	Saesie Tsaeda Emba	63.3	11.5	61.6	17.5
26	Saharti Samere	12.4	8.1	9.6	1.3
27	Tahetay Adiyabo	179.8	62.4	169.1	117.8
28	Tahetay Koraro	15.5	29.2	11.5	16.1
29	Tahetay Maichew	20.7	1.4	19.7	7
30	Tanqua Abergele	75.8	28.1	70.6	20.8
31	Tsegede	38.3	171.1	36.2	36.2
32	Tselemti	34	3.5	31.1	12.8
33	Welkait	-0.65	149.15	-4.8	-4.8
34	Werieleke	18.4	2.8	18.5	-0.1

Source: Computed based on secondary data collected from BOFED.

\* It is not included in the analysis as commercial farm owned by investors is highly practiced in the district

## Appendix B – Questionnaire employed for household interview

District ----- Tabia ----- Village -----

Household Code -----

Name of Household head -----

Package included -----

1. Yes          2. No          If Yes, When -----

1. Type of Household

Male headed ----- Female headed -----

2. Demographic characteristics of household

S.N.	Name of Household members	Sex 1. Male 2. Female	Age	Marital Status 1. Single 2. Married 3. Divorced 4. Widowed 5. Departed	Level of Education 1. No formal Education 2. Read & Write 3. Elementary 4. Junior School 5. Secondary	Main source of livelihood 1. Food production 2. Petty trade 3. Daily labour 4. Livestock	Secondary source
1							
2							
3							
4							
5							

3. Average land holding size (in hectare)? -----

4. How food secured is your household?

❖ Number of months that your household was food secured before 5 years? -----

❖ Number of months that your household is food secured now? -----

5. What is the estimated average annual total household income?

❖ Before 5 years? -----

❖ Now? -----

6. Asset ownership of the household in number

	<b><u>Before 5 years</u></b>	<b><u>Now</u></b>
❖ Oxen	-----	-----
❖ Sheep holding	-----	-----
❖ Goat holding	-----	-----
❖ Poultry	-----	-----
❖ Beehives	-----	-----
❖ Bull's	-----	-----
❖ Cows	-----	-----
❖ Donkey	-----	-----

7. Changes on household & farm implements

	<b><u>Before 5 years</u></b>	<b><u>Now</u></b>
❖ Corrugated Iron	-----	-----
❖ No. of bed	-----	-----
❖ Radio	-----	-----

8. Changes on crop productivity (yield)

8.1 What was your actual amount of production before 5 years?

❖ Teff	-----
❖ Wheat	-----
❖ Barley	-----
❖ Sorghum	-----
❖ Beans	-----
❖ Others	-----

8.2 What was your actual amount of production for the last harvest season?

❖ Teff	-----
❖ Wheat	-----
❖ Barley	-----
❖ Sorghum	-----
❖ Beans	-----

❖ Others -----

9. Do you use modern farm inputs? ----- (1. Yes, 2. No)

9.1 If yes what are these (use a ✓ Mark when ever applied)

- ❖ Chemical fertilizer
- ❖ Improved seeds
- ❖ Herbicides
- ❖ Insecticides
- ❖ Irrigation
- ❖ Extension service

10. What are the coping mechanisms that your household applied during food shortage (or decline in food availability)?

- ❖ Selling household assets
- ❖ Petty trading
- ❖ Selling wood
- ❖ Reducing amount of males
- ❖ Reducing frequency of males
- ❖ Selling charcoal
- ❖ Engaged in FFW
- ❖ Engaged in CFW
- ❖ Daily labour
- ❖ Begging

11. Have you or any members of your household receive credit service from DECSI /FS/WB in the last 5 years? ----- 1. Yes 2. No

11.1 If yes for what purpose did you spend?

- ❖ Education
- ❖ Non farm business
- ❖ Farm inputs
- ❖ Buy cattle

- ❖ Food & clothing
- ❖ Other (specify)

12. Is any member of the household has account in local savings or credit association?

- i. Formal association ----- 1. Yes 2. No
- ii. Informal association ----- 1. Yes 2. No
- iii. Both ----- 1. Yes 2. No

13. Approximately how far (km) is the household located from the nearest

- ❖ Dry weather roads -----
- ❖ All weather roads -----
- ❖ Main market -----

14. How long did you take to reach the main market /road (in minutes/hr)?-----

15. To what extent is the government (leadership) committed to ensure food security?

	<u>5 years ago</u>	<u>Now</u>
5 very high	-----	-----
4 high	-----	-----
3 moderate	-----	-----
2 low	-----	-----
1 very low	-----	-----

16. Do you think these government measures have brought changes in your food security? -----

- 1. Yes
- 2. No

17. To what extent are government measures effective?

- 5 Very high
- 4 High
- 3 Moderate
- 2 Low
- 1 Very low

18. How many plots do you have? -----

19. What is the level of environmental degradation in your parcel?

- (5. None 4. Negligible 3. 2. Serious 1. Very serious)

Parcel 1. -----

Parcel 2. -----

Parcel 3 -----

Parcel 4 -----

20. What are the visible signs of environmental degradation in your parcel?

- (a) Bar soil
- (b) Low vegetation cover
- (c) Deep gullies

- (d) Shallow gullies
- (e) Sheet erosion
- (f) Other (specify)

21. What is the predominant type of environmental conservation on your parcel of land?

- (a) None
- (b) Tree planting
- (c) Terracing
- (d) Following
- (e) Intercropping
- (g) Hedging
- (h) Grass strips
- (i) Other (specify)

22. What proportion of the land is cultivated? (In Tsimdi)

Parcel 1 ----- parcel 2 -----  
 Parcel 3 ----- Parcel 4 -----

23. What has been the condition of the land productivity in the last 5 years? -----

(D = decreasing, I= increasing)

If decreasing, what are the possible reasons? -----  
 -----

If increasing, what are the possible reasons? -----  
 -----

24. Have you participated during the policy formulation? -----

(1. Yes 2. No)

25. What are the problems with government measures under taken?

- a. -----
- b. -----
- c. -----
- d. -----

26. Do you have any additional comment concerning food security?

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**Thank you**