Addis Ababa University

College of Development Studies

Center for Rural Development

Climate Variability and Households' Vulnerability to Food Insecurity in Ethiopia

A Case Study of Boset District, East Shewa

PhD Dissertation

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Acronyms and Abbreviations

ADLI	Agricultural Development Led Industrialization
bn	billion
CIDA	Canadian International Development Agency
CRGE	Climate Resilient Green Economy
CSA	Central Statistical Agency, Ethiopia
DAs	Development Agents
DFID	Department For International Development (UK foreign aid ministry)
EPA	Environmental Protection Authority of Ethiopia
FANTA	Food and Nutrition Technical Assistance Project Academy for Educational Development
FAO	Food and Agriculture Organization of the United Nations
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GHI	Global Hunger Index
GTP	Growth and Transformation Plan of FDRE
HDDS	Household Dietary Diversity Score
HDRP	Humanitarian and Disaster Resilience Plan
HFIAP	Household Food Insecurity Access Prevalence
HFIAS	Household Food Insecurity Access Scale
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy and Research Institute
IPCC	Intergovernmental Panel on Climate Change
KIIs	Key Informant Interviews
kms	Kilo meters
km^2	kilo meter square
MAHFP	Months of Adequate Household Food Provisioning
mm	millimeter

MNL	Multinomial Logit
NDRMC	National Disaster Risk Management Commission
NMA	National Meteorological Agency, Ethiopia
NGOs	Non-Governmental Organizations
PCA	Principal Component Analysis
PRSP	Poverty Reduction Strategy Paper
PSNP	Productive Safety Net Program
SLF	Sustainable Livelihood Framework
SSA	Sub-Saharan Africa
UNDP	United Nations Development Program
UNU	United Nations University
USD	United States Dollar
VIF	Variance Inflation Factor
WASH	Water, Sanitation and Hygiene
WFP	World Food Program of the United Nations
WIDER	The World Institute for Development Economics Research

Abstract

Food insecurity has been a big challenge for Ethiopia in general, and the study area in particular. The problem is getting more complicated when coupled with the unprecedented occurrence of climate variability. Most empirical studies conducted so far employed a single indicator to measure the food insecurity situation that may give only a partial view and neglect to consider especially the social vulnerability aspect of the people concerned. To fill these gaps, a mixed methods research approach was adopted to collect both quantitative and qualitative data and to offset the weaknesses of using either approaches. A total of 397 rural households were selected through systematic sampling technique with a 95% confidence interval from six purposely selected *kebeles*. Data analyses were conducted using techniques that suit the variables and themes considered. It was found that the overwhelming majority of the households have noticed changes in temperature and rainfall. Owing to these facts, households reported reduced yields, complete crop failure, and shortage of water both for animals and people as perceived consequences. So that they pursued various adaptation strategies that encompass crop management and land management related strategies, and diversification into non-farm activities. However, their attempts were constrained by barriers which include financial constraint, shortage of land, lack of water, lack of access to modern inputs, and interference of the rural households by brokers. Likewise, the findings show that more than half (52.6%) of the total households were highly vulnerable to food insecurity. Relatedly, statistically significant difference (p<1%) was observed across the sample *kebeles* in terms of their levels of vulnerability. With regards to food insecurity situation, the suite of indicators employed revealed that large majority of households were found to be food insecure, despite some differences across the indicators. To make matters worse, respondents that account about 56.9% had no access to safe drinking water; 46.1% did not have their own latrine; and 64.0% of the respondents disposed waste in an open field and in their garden. Furthermore, results on the causes of the prevailing food insecurity also showed the existence of multiple causes which are reinforcing each other and influencing at different levels. It is believed that institutions, both formal and informal, have critical roles to play in curbing problems of food insecurity. Yet, results of the study showed that the institutions played unsatisfactory roles. In conclusion, it can be said that the recurrent drought was depleting the meager resources at the disposal of households which make them more vulnerable to food insecurity. Besides, the multiple causes of food insecurity coupled with the existence of an array of barriers to adaptation could further complicate matters. Thus, attention should be given to all these interwoven factors and work in collaborative manner so that lasting solutions could be provided to resolve problems of food insecurity.

Keywords: Adaptation strategies; Climate variability; Food insecurity; Institutions; Perception; Vulnerability; Rural households; Ethiopia

List of papers

All the discussions in this dissertation are based on the following four papers referred to by their Roman numerals.

Paper I: Getachew Teferi Moroda, Degefa Tolossa, and Negussie Semie (2018). Perception and Adaptation Strategies of Rural People against the Adverse Effects of Climate Variability: A Case Study of Boset District, East Shewa, Ethiopia. *Environmental Development 27 (2018) 2–13*. https://doi.org/10.1016/j.envdev.2018.07.005

Paper II: Getachew Teferi Moroda, Degefa Tolossa, and Negussie Semie. Vulnerability to Food Insecurity in the Face of Climate Variability: An Integrated Vulnerability Assessment Approach - A Case Study of Boset District, East Shewa, Ethiopia. (Submitted to Ethiopian Journal of Development Research)

Paper III: Getachew Teferi Moroda, Degefa Tolossa, and Negussie Semie (2018). Food Insecurity of Rural Households in Boset District of Ethiopia: A Suite of Indicators Analysis. *Agric & Food Secur (2018) 7:65.* https://doi.org/10.1186/s40066-018-0217-x

Paper IV: Roles of Institutions in Curbing Food Insecurity in the Face of Climate Variability: The Case of Boset District, East Shewa (Manuscript)

Chapter 1: Introduction

1.1 Background to the Study

Majority of the population in this world, especially those of the developing countries, live in the rural parts. These parts of the developing world are known for their deprivation of basic infrastructure and confronted with so many concomitant problems. Out of all the problems encountered "about 80% of the hungry worldwide live in rural areas …" (Tobin, 2009, p. 13). In Sub-Saharan Africa, for instance, about 70 percent of the extreme poor live in the rural areas (Ravallion *et al.*, 2007). That is why it was argued that food insecurity remains as the major concern for developing countries where their majority of the population reside in the rural parts (Boratynska & Huseynov, 2017).

As early as 1996 it was forecasted that "food scarcity will be the defining issue of the new era now unfolding …" (Brown, 1996, p. 19). This is because, according to Brown, no identifiable technology is waiting in the wings that will lead to a quantum jump in food production comparable to those that came from earlier technological gains. After a decade Brown has predicted the challenge of the world, Easterling (2007) also attested that one of the great challenges of the 21st century will be to increase the global food supply to accommodate a world growing to 10 billion or more people while undergoing climate change (see also Kang *et al.*, 2009; Westerhoff & Smit, 2009). As an illustration, Munang *et al.* (2011) have shown that 10 million people are dying from hunger each year, which is a shocking fact.

Among the different parts of the developing world, Africa south of the Sahara in particular was claimed to be the most food-insecure region (Baro & Deubel, 2006; Conceicao *et al.*, 2016). The sub-Saharan Africa (SSA) region suffers from different constraints that contribute for the precarious situation of food security which may include a combination of political ignorance, population growth, and adverse effects in terms-of-trade-development (Exenberger & Pondorfer, 2011); low agricultural productivity, limited rural development, government policy disincentives, poor health, rising global commodity prices, and climate change (Tobin, 2009); a combination of problems that range from political-economic crises, HIV/AIDS, structural poverty and poor policy decisions (Clover, 2003); and increased foreign indebtedness, the decline in aggregate and

per capita food production, and mounting pressure on the natural environment, expansion of conflicts and war, unfavorable climatic conditions, and poor policies (Getachew, 1995).

From all the constraints faced by the SSA countries the one with a profound effect could be the neglect of the agricultural sector over the past decades (Aabo & Kring, 2012). This can be justified by the existing low-tech, labor-intensive, capital-scarce rain-fed agriculture (Exenberger & Pondorfer, 2011). These authors stressed that generally it is clearly a living "on the margin". Nonetheless, SSA's future food security will still hinge on its agriculture for two reasons (Conceicao *et al.*, 2016). First, agriculture determines food availability, especially where transport is costly and trade is uncertain, and where food needs cannot be easily met through trade and imports. Second, agriculture also determines food entitlements for the 70–80 percent of poor Africans that rely on its production for income and work (Conceicao *et al.*, 2016).

It is most striking that people in Africa are suffering from the vagaries of food insecurity amidst plenty (Degefa, 2005). To this end, Tekolla (1997) in a similar vein indicated that there is a puzzling paradox in the African context. According to him, on one hand Africa has a titanic resource potential; and, being one of the poorest regions of the world, on the other hand. Tekolla stressed this paradox begs special attention of anyone who is concerned with the wellbeing of one's fellow people.

The other area of big concern for the Africa's rural population in general and which also holds true for Ethiopia is related to climate variability and their vulnerability. Scholars have demonstrated that the negative impact of climate change "… is expected to worsen in SSA given its geographic location, limited adaptive capacity, widespread poverty, political instability and existing low levels of infrastructure development and policy support" (Ghimire *et al.*, 2016, p. 91). Thereby, it can be imagined how much an uphill it could be overcoming food insecurity for SSA people. This is because food has always been linked to environmental conditions with production, storage and distribution, and markets all sensitive to weather extremes and climate fluctuations (Liverman & Kapadia, 2010); and the challenge of enhancing food security without further compromising environmental and social welfare outcomes is significant (Ericksen *et al.*, 2010; Liverman & Kapadia, 2010).

Furthermore, scholars have shown that due to the high poverty rates, high vulnerability levels, and low adaptation capacities the developing world in general and SSA in particular are expected

to fare worst, given that temperatures are generally already high, and most of the region's inhabitants depend for their livelihoods on rain-fed agriculture (Ringler *et al.*, 2010). As to the impacts of vulnerability, it was argued that "… because human activities and species are exposed to drivers of change and inherently display both sensitivity and adaptive capacity, they can be considered vulnerable entities in their own right, with important consequences for humans" (Berry *et al.*, 2006, p. 190). Moreover, in showing the ill-effects and the dynamics of vulnerability, Ellis and colleagues (2009) have explained that households that have experienced one or more shocks, depleted their assets to cope with those shocks, are often unable to rebuild their assets before the next crisis occurs, resulting in a spiral downwards into destitution.

When it comes to Ethiopia, scholars like Degye, Belay, and Mengistu (2013) have contended that there is a high level of food insecurity with significant idiosyncratic and spatial characteristics in Ethiopia. This line of argument was complemented that food production has not been sufficient to enable the rural population to be food secure (Tesfahun *et al.*, 2015). Additionally, Ethiopia's agriculture is mainly rain-fed that involves many subsistent farmers (Temesgen *et al.*, 2009; Belay & Dawit, 2017); and that climate change is posing particular risks to poor farmers and pastoralists who have an immediate daily dependence on climate sensitive livelihoods and natural resources (Alebachew & Aklilu, 2012). Likewise, Dercon (2004) demonstrated that a 10 percent rainfall decrease in one year has an impact of 1 percent point on the current growth rates. Abate has also added that "even a look at the Ethiopian GDP growth is closely tied with rainfall – when the country gets adequate amount of annual rainfall, the GDP goes up, and when there is shortage of precipitation, the GDP strikingly goes down" (Abate, 2013, p. 2). As a consequence "… food requirement of Ethiopia remains at the mercy of climate" (Abate, 2013, p. 3).

A document prepared by Oromia Bureau of Agriculture (2014) showed that out of the 18 administrative zones and 265 districts of Oromia National Regional State, 9 zones and 79 districts were chronically food insecure. According to the same document, East Shewa is one of the zones that comprised three districts identified as chronically food insecure, namely: Boset, Fantalle, and Adami Tulu - Jido Kombolcha. Particularly, a document from Boset District Finance and Economic Development Office (2012) has revealed some constraints prevailing in the district that could have a strong implication on food security of the people in general. Among

the constraints identified increased unemployment rate, soil degradation, lack of implementation capacity among office workers, widespread dependency syndrome, and the gradual expansion of desertification were included.

Furthermore, a study conducted by Emebet (2013) showed that the average amount of rainfall for Boset District for the years 1981-2010 was found to have a rate of variation of about 35%. The study asserted the occurrence of strong rainfall variability and a trend of decline in the pattern of rainfall. Emebet also illustrated that in the period between 1981 and 2010, one moderate and four severe droughts in *meher*[1]and ten severe droughts in *belg*[2] seasons have occurred. According to her, all the four severe droughts which occurred in *meher* season took place between 2003 and 2010 showing that the occurrence of drought has increased over time (Emebet, 2013). It can be understood that the strong rainfall variability coupled with the ever increasing trend of drought occurrence may highly threaten the food security of the population in the district.

Needless to say, the threat of climate variability and change is so profound that deserves serious consideration. That is what the IPCC report indicated that climate change adds an additional burden to poor people and their livelihoods, acting as a threat multiplier (IPCC, 2014). More specifically, scholars have emphasized that the effects of climate variability and change on the dimensions of food insecurity are so crucial that the impact on increased vulnerability to food insecurity is quite significant (Karfakis *et al.*, 2011; Peacock, 2012). As an illustration, Birara *et al.* (2015) have highlighted that Ethiopia's agriculture is incredibly sensitive to shifts in weather. When rainfall is erratic or insufficient for even a few successive rainy seasons, the entire country is prone to fall into famine (Birara *et al.*, 2015). Similar claim was also made by Arragaw & Woldeamlak (2016) who stated that as Ethiopia's agriculture is dependent on rainfall, the influence of climate variability on crop production is generally large.

To sum up, it was with due acknowledgment of the high prevalence of food insecurity in Ethiopia in general, and the study area in particular, and also with the recognition of the multifaceted and the debilitating consequences of food insecurity that this study was initiated. This can be further justified on the grounds that food is fundamental to human wellbeing

[1]*Meher* is long and heavy rainy season/post-kiremt harvest

[2]*Belg* is short rainy season from March to May (in highland and mid-land areas)

(Misselhorn *et al.*, 2012); work productivity is often impaired among undernourished adults (Tobin, 2009); in its extreme form food insecurity could also result in spatial dislocation and the accompanying dismemberment of families which could shatter the social fabric having both social and psychological impact that may linger for years (Mesfin, 1986); and more comprehensively, there are fundamental threats posed by food crisis which include that hunger is a major constraint to a country's immediate and long term economic, social and political development (Ilaboya *et al.*, 2012).

1.2 Statement of the Problem

It was in Dilla town, just before joining for my PhD study that I observed so many long vehicles loaded with full of sacks, that problem of food insecurity crossed my mind. During that moment, I asked a friend what are all those vehicles for? He replied "this is almost every year that food aid is transported to communities of Borana and Somali". Then, I started pondering 'for how long the government could support those people?'; 'can the government afford to provide such support to people in need all over the country?'; 'is there no way-out from this trap?' and, after all "why is food insecurity so recurrent?" Thus, that was the instance which gave me the impetus to study on food insecurity. In fact, when I joined the PhD program and read different materials, I found so many more compelling reasons to study problems of food insecurity.

When one traces back Ethiopia's situation on food insecurity, the problem has been a serious challenge for a very long time (Mesfin, 1986; Markos, 1997; Degefa, 2005; Messay, 2012; Belay & Dawit, 2017). Of course, in recent years the country is doing good in reducing the proportion of the population who are food insecure. As was compiled by Guyu (2015) the population of Ethiopia who were living below the food poverty line measured in head count ratio have shown a steady decline from 52% in the 1980s to 43% in 1995/96, 38.7% in 2004/05, 35.6% in 2005/06, and 33.3% in 2006/07. The Central Statistical Agency (CSA) and World Food Program [WFP] (2014) have revealed in 2010/11 it was 28% of the population who fell below the food poverty line. Besides, the NPC (2017) showed the food povetry index for 2015/2016 is 24.8%.

Similarly, the 2017 Global Hunger Index (GHI) indicated that Ethiopia has achieved a significant improvement since 2000, from a GHI score of 56.0 to 32.3. Yet the GHI score which was calculated for 119 countries showed that Ethiopia was found to stood 104th with GHI score of 32.3, which falls in the *serious* severity scale (von Grebmer *et al.*, 2017). Despite the gradual

improvements, however, even the current status indicates there is no need for complacency since the absolute number of food insecure people is still high (Guyu, 2015).

When the problem of food insecurity in Ethiopia is seen in terms of the level of nutritional deprivation, which is comprised of stunting and wasting of children less than five years of age, it was found that 38% of children under 5 are considered short for their age or stunted, and 18% are severely stunted; and overall, 10% of children in Ethiopia are wasted, and 3 percent are severely wasted (CSA & ICF, 2016). With regards to ownership of sanitation facilities and hygiene practices, the demographic and health survey conducted by CSA and ICF (2016) also showed that only two-thirds of households in Ethiopia (65 %) obtain their drinking water from an improved source. Besides, 50% of households in urban and 94% in rural use an unimproved toilet facility, and overall, 32 percent of households have no toilet facility at all; they are almost exclusively rural, accounting for 39 percent of rural households (CSA & ICF, 2016).

Notwithstanding all the efforts made, it is disappointing that the number of food poor has increased in four out of the eleven regions (for the years 1995/96-2010/11), with largest shares seen in Gambela, Afar, Oromia and Somali (CSA & WFP, 2014). Besides, a recently released Humanitarian and Disaster Resilience Plan (HDRP) by the Government of Ethiopia revealed that the food crisis is still an appalling problem. The plan document showed that there have been 10, 8.5, and 7.9 million people who depended on relief food assistance for the years 2016, 2017 and 2018, respectively (National Disaster Risk Management Commission [NDRMC], 2018). It should be noted that, the figures highlighted above do not include those under the routinely supported PSNP beneficiaries, which account for 7.9 million chronically food insecure.

More specifically, Boset is known as one of the chronically food insecure districts. This could be partly due to the soil related sensitivity and climate aridity problems in the district. In addition, an increased rate of resource degradation, salinity and clearance of vegetation cover coupled with bad agricultural practices and misuse/overuse of resources were the other problem areas identified (Boset District Finance and Economic Development Office, 2012). Similarly, a study conducted by Emebet (2013) also affirmed that farmland, settlement and bare/degraded lands have shown an increasing trend, whereas bush /shrub lands and grass lands showed a significant reduction, and especially forests were totally cleared from the area. At this point, one can

observe the implications of these problems in constraining agricultural productivity in general, and the food security situation of the district in particular.

Given the overview of the food insecurity situation, the main argument of this dissertation is that food insecurity is recurrent due to the unprecedented climate variability and other multiple causes, weak adaptive capacity, high vulnerability, and the ineffective roles of institutions. With this in mind, there are some more reasons that make it imperative to investigate the problems of food insecurity. Previous studies have noticed that despite the precedence given to tackle food insecurity by the government of Ethiopia and the various efforts made so far on the part of different organizations, the problem still continues (Vadala, 2009; Gill, 2010; Guyu, 2015; Belay & Dawit, 2017). In addition, an intensive review of prior research works was undertaken so as to find out research gaps and establish a niche for this study. These research gaps are discussed in the following paragraphs.

First, climate variability which could be expressed in terms of rainfall variability and associated droughts has been major causes of food insecurity and famine in Ethiopia (NMA, 2007; Conway & Schipper, 2011). Relatedly, identifying the limits to and potential of adaptation is the basis on which food insecurity can be prevented (Davies, 1996). Given this, knowing how farmers perceive climate variability and adapt to it is required to contain the resulting consequences (Temesgen *et al.*, 2011; Adugna *et al.*, 2013). Thus, scholars like Thornthon *et al.* (2010) have suggested that in east African context, where Ethiopia is part, more localized assessments of adaptation options are needed (see also Woldeamlak & Dawit, 2011). This is notwithstanding the fact that there were so many research works conducted in Ethiopia on adaptation. However, those studies conducted so far mainly focused on the Blue Nile Basin (e.g. Temesgen *et al.*, 2009; Dejene, 2011; Muluneh & Demeke, 2011; Woldeamlak & Dawit, 2011; Gebre *et al.*, 2015) and southeast of Ethiopia where Haramaya University is located (e.g. Aemro *et al.*, 2012; Belaineh *et al.*, 2013; Yibekal *et al.*, 2013; Dirriba & Jemma, 2015). Of course, this location bias is also attested by Arragaw & Woldeamlak (2016).

Second, whenever food crises happen in different parts of Ethiopia, the authorities rush to attribute the causes to natural disasters, mainly drought (see e.g. NDRMC, 2018); with less attention given to the vulnerability aspect of the community concerned (Lautze & Maxwell, 2007; Ali, 2008; Lemma & Wondimagegn, 2014; Sandstrom & Juhola, 2017). In contrast,

research findings show food insecurity is mainly caused due to human failures (Degefa, 2005; Sorensen & Selome, 2009; Vadala, 2009). To settle these divergent views on vulnerability, a middle ground is required that accounts for both bio-physical and socio-economic elements. In fact, it should be noted that there were pioneering works on vulnerability to food insecurity (like Mesfin, 1986) and a few other recent works on similar topic (e.g. Ali, 2008; Lemma & Wondimagegn, 2014; Mesfin Welderufael, 2014; Tesfahun *et al.*, 2015). These previous research works used their personal account, the Value at Risk, and Foster-Greer-Thorbecke (FGT) models to analyze the vulnerability levels of households. In contrast, in this study the Integrated Vulnerability Assessment approach was pursued so as to take into account both the bio-physical and social aspects of vulnerability.

Thirdly, despite the fact that there were so many research works conducted to assess the status of food insecurity in Ethiopia, the large majority of them employed a single indicator (e.g. Abebaw & Ayalneh, 2007; Maes *et al.*, 2009; Messay, 2009; Alemseged, 2016; Garedew, 2017; Abayineh & Belay, 2017; Malla *et al.*, 2017). The point here is that the use of a single indicator is said to give a partial view of the dimensions of food (*in*)security (Coates, 2013; FAO *et al.*, 2013) that will result in less effectiveness of interventions. Hence, to overcome such shortcomings a suite of indicators is used in this study.

Lastly, the roles of institutions (both formal and informal) in tackling food insecurity are so crucial. That is why it was partly contended that it is really difficult to understand the rural livelihood as a whole and the food insecurity situation without understanding the roles played by the informal institutions (Degefa, 2009). Nonetheless, IFPRI (2011) mentioned that the roles of institutions in enabling the poor to accumulate assets or constraining them are little known. Besides, it has been observed that the incumbent authorities in Ethiopia attribute the causes of food crisis mainly to natural disasters, which calls for a critical appraisal of such attributions. It is believed, the assessment of the roles of institutions could help in identifying areas where corrective measures are needed and/or to harness the benefits from the strong sides.

Given the existing food insecurity situation and the research gaps identified in the preceding paragraphs, this study has tried to address the following main research questions:

i. How do rural households perceive and experience the effects of climate variability?
ii. What are the adaptation strategies of households for events of climate variability?

iii. What are the levels of vulnerability to food insecurity for households residing in the study area?
iv. What does the food insecurity situation of households living in the study area looks like?
v. Why do the rural households are food insecure in the study area? and
vi. How do different institutions respond to address food insecurity in the face of climate variability?

Thus, this dissertation aims to investigate and explain answers to these questions. With recognition of the fact that perception and adaptation to climate variability, and vulnerability to food insecurity are spatio-temporally dependent; many of the research works done so far on food insecurity used mainly a single indicator; and vulnerability to food insecurity being overlooked both by researchers and the incumbent authorities, this study has attempted to fill these contextual and literature gaps. To this end, a mixed methods research approach was opted for to generate the requisite data. Thereby, the findings of this study could complement on the extant literature, reorient government and non-governmental organizations who have been preoccupied with thinking food insecurity as caused by natural disasters, and motivate more researchers to study food insecurity in its multi-dimensionality taking vulnerability as a guiding concept.

1.3 Theoretical Underpinnings

There are many theoretical underpinnings that explain the occurrence of food insecurity and famine. Wisner and colleagues (2004) have contended that among the different theories of food insecurity *no single theory* [emphasis added] is dominant or capable of excluding the others. Cognizant of this fact, three theoretical perspectives are considered in this study to comprehensively explain the interaction of the variables under investigation. First, 'the climatic and environmental theories' is chosen since one of the interest is to look into the interplay of climate variability and food insecurity. Second, it is considered 'food insecurity as an outcome of vulnerable livelihood' as the other theoretical orientation so that vulnerability of households to food insecurity could be explained. Lastly, 'the political economy explanation' is chosen as additional theoretical orientation because of the belief that institutions could make-or-break as far as food insecurity is concerned.

In relation to the use of different theoretical underpinnings, scholars have justified the benefits on many grounds. For instance, Belaineh (2003) has reviewed various studies and come up with

the idea that rural livelihoods are diverse and complex. It follows that the complexity of the issues cannot be accommodated within a single theory, thus Belaineh contended for the use of a wide theoretical framework. In addition, Mistry (2011) has also argued that "the more we are able to compare, distinguish, clarify, and synthesize constructs across varying theoretical perspectives, the better position we will be in to move towards integrative perspectives …", which could hold true for the realities in the rural areas. Similarly, Degefa (2006) when argueing for the use of multiple theoretical underpinnings, he states that "famine being a multi-faceted socio-economic problem, and hence a research depending on single philosophical underpinning cannot come out with comprehensive knowledge of it". Thus, it is argued in this study that a better understanding of the food insecurity situation could be attained through the three theoretical underpinnings considered which are briefly reviewed below.

1.3.1 The climatic and environmental theories

Theories of food insecurity based on climatic variability or environmental degradation can be divided into two groups (Devereux, 2001). These include theories based on long-term processes ('climatic/environmental determinism') and those based on climate-triggered livelihood shocks ('bad weather events'). According to Devereux, 'climatic-determinists' make alarmist projections based on observations of deteriorating meteorological or environmental indicators. In contrast, 'bad-weather' analysts examine the impact of drought or flood on livelihoods, food supplies, and access to food. In line with this, Dawning (1992) as cited in Wisner *et al.* (2004) indicates that "… global climate change has emerged as an additional factor in explanations of the reduction or disruption of food output, especially in relation to drought" (p. 121). Wisner and colleagues have added that it is becoming a major focus in understanding the possible increase of extreme events, in which natural hazards are magnified in intensity and frequency.

As far as climatic and environmental processes' argument is concerned, Devereux (2001) describes that the points of focus are desertification, global warming and related matters. Accordingly, it is illustrated that a combination of arable land lost to population pressure, deforestation and overgrazing, together with the possibility of a long-term decline in rain-fall in dryland farming areas in Africa and Asia, will cause declines in crop production and exacerbate food insecurity in already marginal areas, leading eventually to famine.

As per the second strand, i.e. bad weather events, Devereux (2001, p. 128) states that the mechanisms whereby drought can lead to famine is straightforward but multi-dimensional. First, a drought reduces crop production (so it undermines direct access to food by producers). Second, drought reduces the value of assets that people can sell to buy food (livestock become thin and die, and there is an oversupply of livestock and other assets on the market as people sell or barter their possessions for food). Third, drought raises food prices because large numbers of people shift being self-provisioning food producers to being market dependent consumers (so drought threats access to food through the market). Fourth, drought reduces employment opportunities because of its contradictory effect on local economies (so earned income for purchasing food is also reduced). Finally, drought reduces informal support systems because of 'covariate risks' – if everybody in the area is equally affected, the ability of richer community members to help their poor neighbors is impaired (so drought threatens access to food through local 'moral economy' transfers).

As to the applicability of this theoretical underpinning in the Ethiopian context, one may see the point made by Markos (1997). In his study of the Northern Ethiopia, Markos argues that drought has longer-term effects in reducing the economic base of households, thereby leading to chronic and acute food insecurity.

As far as limitations of this theory are concerned, Devereux highlights that this theory is controversial mainly because the evidence on the scale and impact of 'desert creep' is inconclusive; the theory has also a tendency to view the poor and vulnerable as passive victims who take no action in response to long-term threats to their livelihoods; the assertion that drought equates with food insecurity is too simplistic, because it assumes a totally closed economy; and, final critique is that while many parts of the world have suffered severe droughts but these have not produced the food crisis that occurred in Africa (Devereux, 2001, p. 127-128).

1.3.2 Food insecurity as an outcome of vulnerable livelihood

Food insecurity as an outcome of vulnerable livelihood can be described through the use of the sustainable livelihood framework (SLF). The framework is comprised of five interrelated components: capital assets, existing context, mediating processes, activities and strategies, and livelihood outcomes (Ellis, 2000; Degefa, 2010). The capital assets owned, controlled, claimed, or by some other means accessed by the household are in turn grouped into five categories

(Allison & Horemans, 2006). These comprise physical capital; financial capital; natural capital; human capital; and social capital (Allison & Horemans, 2006). The access to both assets and activities is enabled or hindered by policies, institutions and processes (Allison & Horemans, 2006), which could lastly determine the levels of food insecurity.

Notwithstanding the crucial roles of each of the components in the SLF, Degefa (2005) has cited scholars (like Scoones, 1998; Ellis, 2000) and explained that "whether a household's livelihood is sustainable or vulnerable, or food secure or not, largely depends on the interplay between access to various forms of assets, the existing context (history, trends and vulnerability/shock), the mediating processes (institutions, organizations and social relations at work), the activities, and the resulting livelihood strategies that a household pursues" (p. 85). So it can be implied that food insecurity could occur whenever either of the elements of the interplay fail to manifest as is expected.

Similar argument was also made by Davies (1996) as cited in Devereux (2001) that "food security is a subsystem of needs, neither independent of nor necessarily more important than other aspects of subsistence and survival within poor households" (p. 90). Devereux further argues that the reasons some households are food insecure are rooted in the ways entire livelihood systems have changed and adapted, or failed to adapt, to challenges from the ecological and economic environment, including shocks such as drought. Thus, food security is usefully seen as one important element of a sustainable livelihood. Likewise, Connolly-Boutin and Smit (2016) have mentioned that "framing food security as an integral part or an outcome of a livelihood strategy recognizes that a host of stresses can interact to affect food security at a household or individual level" (p. 389).

Furthermore, Wisner *et al.* (2004) describe that food insecurity as an outcome of vulnerable livelihood approach is a way of looking at food security from a holistic perspective. Consequently, it represents a shift in thinking away from a narrow 'food first' approach to a much broader spectrum of policy issues which address access to income opportunities in all sectors.

In a study that examined urban poverty and food insecurity in Addis Ababa City, Degefa (2010) succinctly described that poverty and food insecurity could be better examined through the use of the SLF. Furthermore, there are studies conducted in the Ethiopian context which used the SLF

as an analytical framework and theoretical underpinning which include Messay (2012), and Abayineh and Belay (2017).

1.3.3 The political economy explanation

As far as this theory is concerned, Wisner and colleagues (2004) discuss that food insecurity could happen in a given society when they are lacking the political conditions for an anti-famine contract (i.e. a contract which makes it morally imperative for the state to act in the interest of the electorate) that could have helped in the timely and effective action to prevent famine. For de Waal (1997) an anti-famine political contract includes "… a political commitment by government, recognition of famine as a political scandal by the people, and lines of accountability from government to people that enable this commitment to be enforced" (p. 2).

This theoretical approach advances the causes of contemporary food insecurity are never purely technical crop failure, food price rises, and so on (Devereux, 2001). Rather, all food insecurity situations could be explained by a combination of 'technical' and 'political' factors, where political factors include bad government policies, failure of the international community to provide relief, and war (Devereux, 2001). This approach was evidenced by Devereux (2001) considering the case of African famines which have evolved from being triggered mainly by drought to being triggered mainly by civil war, and even when drought is the trigger, national governments and the international community are increasingly held accountable for failing (or refusing) to prevent the drought from developing into famine.

Similar argument was also made by de Waal (1997) after observing the occurrence of famine in different parts of Africa. According to de Waal, famine is conquerable. This is becase it has been eradicated from most of the world. For de Waal famine is a tragedy and scandal, and also "... tempting to think of the expanding humanitarian enterprise as a heroic effort to keep up with a runaway juggernaut of war and natural disaster, which is somehow always too big and intractable to be stopped" (de Waal, 1997, p.1). de Waal contends that the humanitarian action is a certain kind of political action which acts less as a break on the juggernaut of famine, and more as an element in the fuel that keeps the monster moving.

Wisner *et al.* (2004) view this theory in the sense that closed and totalitarian societies tend to collect information through the eyes of party officials who have their own circles and statistical

collection techniques. This could lead to incorrect information about food security and food stocks, the silencing of the voices of the hungry, and a dearth of information about the true state of the disaster reaching the outside world. For Devereux (2001) the political economy explanation can also be expressed in terms of the political powerlessness of the victims. He further explains that the real roots of food insecurity may lie less in lack of purchasing power within the market (although this will be one of the mechanisms of food insecurity) than in a lack of lobbying power within national (and international) institutions.

Cohen and Werker (2008), on their part, describe that governments can use natural disasters to redistribute power through the *political effect*, favoring disaster spending in regions that are politically aligned with the party in power. On the other hand, the addition of humanitarian aid to the model produces a *bailout effect*: governments under-invest in disaster prevention when they know that they will be bailed out in the event of disaster (Cohen & Werker, 2008). In the extreme, the same authors contend, a *racket effect* can be witnessed, where governments can deliberately neglect a population so as to attract—and steal—humanitarian aid in the event of a disaster. Governments without other sources of external income are more likely to be influenced by the racket effect.

With respect to the political economy explanation, Cohen and Werker identify Ethiopia to be a nation that regularly makes headlines for famine threat, which serve as is a salient example. The authors illustrate, because relief aid is forthcoming for the perennially food-insecure country, it can delay reforms that seek to address the underlying issues of food security. The availability of competently-delivered outside food aid means that the Ethiopian government does not need to stake its political future on solving the food insecurity problem. Certainly, it needs to expend some resources to improve the situation, yet resources that would have been spent on alleviating the structural causes of hunger in the absence of global humanitarians are freed up for other purposes (Cohen & Werker, 2008).

Hence, according to this theoretical approach the point is that whatever the causes of food insecurity it can be prevented before developing into a full scale problem had it not been for the deliberate inaction, inappropriate policy or deliberate ignorance of the problem by those holding government positions and/or the international community. As far as solutions for such ineffectiveness is concerned, Nabarro (2011) as cited in Aabo and Kring (2012) have suggested

that while measures should be taken to control future resource consumption and population growth, the key to reduce the prevalence of hunger is to ensure universal access to food, through policy measures which tackle the challenges of distribution and affordability of sufficient quantities of nutritious food among deprived groups.

Similarly, Vadala (2009) and Aabo & Kring (2012) have taken statement from Sen (1999) and stated that 'there has never been a famine in a functioning multiparty democracy' and asserted that, indeed, resolving the problem of food insecurity is in the hands of those holding government powers. Thus, the authors added that in order to prevent food insecurity, economic rights like the right to food, civil and political rights are of utmost importance.

To best exemplify the applicability of this theory, it is possible to look the arguments advanced by Mesfin (1986) from his study on 'Rural vulnerability to famine in Ethiopia'. Mesfin put foreward that the role of government in food insecurity took two forms, acts of commission and acts of omission. On the one hand, in the form of commission, the government accentuates the vulnerability of the peasants through direct and indirect oppression and exploitation, for example through corruption and bribery. On the other hand, he argues that food insecurity is a catastrophic process, not a catastrophic event. He extends that the failure of higher authorities of government to make the appropriate decisions in time, and their failure to organize public support for effective relief effort are what constitute the government's sin of omission.

1.4 Objectives of the Study

The main objective of this study is to examine the interplay of climate variability and vulnerability to food insecurity in Boset District of East Shewa Zone, Oromia National Regional State.

More specifically, the study aims to achieve the following specific research objectives[3]:

i. To explore rural households' perceptions and experiences on the effects of climate variability (Paper I);
ii. To assess the adaptation strategies of people for events of climate variability (Paper I);
iii. To measure the levels of vulnerability to food insecurity of the rural households (Paper II);
iv. To examine the food insecurity situation of the people living in the study area (Paper III);

[3]Note: The reference period that the research objectives seek to address was the last 10 years (i.e. 2006-2015).

v. To identify the causes of food insecurity in the study area (Paper IV); and,
vi. To investigate the roles of institutions in addressing food insecurity in the face of climate variability (Paper IV).

1.5 Research Methodology

1.5.1 Philosophical foundation

According to Creswell (2009) there are about four philosophical worldviews that one may choose to employ in conducting a research work, namely: the post-positivist, the social constructivist, the advocacy and participatory, and the pragmatic worldviews. Either of these worldviews could be used based on the nature of the problem one is investigating, the purpose of investigation, and familiarity with the concomitant research methods (Creswell, 2009). Consequently, among the four worldviews, the pragmatic worldview is pursued for this particular study.

It was explained by Creswell (2009) that the pragmatic worldview arises out of actions, situations, and consequences rather than antecedent conditions. Quoting different authors, Creswell (2009) described that in this worldview there is a concern with applications – what works – and solutions to the problems. With regards to methods, Creswell argued researchers are not focused on methods rather they emphasize on the research problem and use all approaches available to understand the problem. He contended that pragmatism is not committed to anyone philosophy and reality. This applies to mixed methods research in that inquirers draw liberally from both quantitative and qualitative assumptions when they engage in their research.

Creswell and Clark (2011) also suggested that pragmatism as a worldview is typically associated with mixed methods research. The focus is on the consequences of research, on the primary importance of the question asked rather than the methods, and on the use of multiple methods of data collection to inform the problems under study. Thus, it is pluralistic and oriented toward "what works" and practice.

1.5.2 Research approach

For undertaking this study a mixed methods research is the preferred approach employed. The choice of this approach is mainly dictated by the nature of the research problem under investigation. Besides, the benefits that could be obtained by using the mixed methods approach

were appealing. To this end, Creswell (2009; 2012) has described that the basic assumption is that the uses of both quantitative and qualitative methods, in combination, provide a better understanding of the research problem and question than either method by itself. In addition, it was shown that "a key feature of mixed methods research is its methodological pluralism or eclecticism, which frequently results in superior research (compared to mono-method research)" (Johnson & Onwuegbuzie, 2004). On top of this, Johnson and Onwuegbuzie added that the goal of mixed methods research is not to replace either of these approaches (qualitative and quantitative) but rather to draw from the strengths and minimize the weaknesses of both in single research studies and across studies. Creswell and Clark (2011) have similarly argued that mixed methods research provides strengths that offset the weaknesses of both quantitative and qualitative research.

Furthermore, Creswell and Clark (2011) also mentioned that mixed methods research provides more evidence for studying a research than either quantitative or qualitative research alone. These authors added that researchers are free to employ most of the tools of data collection available rather than being restricted to the types of data collection typically associated with quantitative research or qualitative research.

Nagy and Hesse-Biber (2010) quoting different authors have argued mixed methods research is a rich field for the combination of data because with this design "words, pictures, and narratives can be used to add meaning to numbers" (p.3). In other words, Nagy and Hesse-Biber further elaborated, when qualitative data are combined with quantitative, numerical data from a larger-scale study on the same issue, they could allow the research results to be generalized for future studies and examinations.

In a more comprehensive way, Greene *et al.* (1989) as cited in Nagy and Hesse-Biber (2010, p. 3-5) have identified five specific reasons why researchers should consider using mixed methods. These include:

- The first reason is ***triangulation*** which refers to the use of more than one method while studying the same research question in order to "examine the same dimension of a research problem".
- The second reason is ***complementarity*** that allows the researcher to gain a fuller understanding of the research problem and/or to clarify a given research result.

- The third reason is ***development***, i.e., it often aids in the development of a research project by creating a synergistic effect, whereby the "results from one method . . . help develop or inform the other method".
- A fourth reason mentioned is ***initiation***, a study's findings may raise questions or contradictions that will require clarification, thus initiating a new study; and,
- Finally, the fifth reason is ***expansion***, which is intended to "extend the breadth and range of the inquiry".

In fact, so many scholars who conducted empirical studies in the Ethiopian context (to mention few Degefa, 2005; Ali, 2008; and Abate, 2013) have all used the same approach for reasons which comprise to exploit the advantages of both qualitative and quantitative methods while minimizing the weaknesses of exclusively relying on one method, and to enhance the integrity of research findings by supplementing them from different angles.

In terms of procedures, a concurrent mixed methods procedure was followed in this study. According to Creswell (2009) when using this procedure, the researcher merges quantitative and qualitative data in order to provide a comprehensive analysis of the research problem, i.e. both forms of data are collected at the same time and then integrate the information in the interpretation of the overall results. However, among the two forms of data used in this study, it should be noted that the use of quantitative data appears to be a bit dominant over the qualitative one.

Based on the need to reflect on interaction, priority, timing, and mixing a researcher employing a mixed methods could choose among the major mixed methods design (Creswell & Clark, 2011). According to these authors, there are about six major mixed methods designs that provide a useful framework for researchers working to design their own studies. These designs include the convergent parallel design; the explanatory sequential design; the exploratory sequential design; the embedded design; the transformative design; and, the multiphase design. The selection among these designs is made based on choosing a design that best matches the research problem and reasons for mixing in order to make the study manageable and simple to implement and describe.

Thus, in this study the convergent parallel design (also called the convergent design) is opted to be used. This design occurs when the researcher uses concurrent timing to implement the quantitative and qualitative strands during the same phase of the research process, prioritizing the

methods equally, and keeps the strands independent during analysis and then mixes the results during the overall interpretation.

1.5.3 Data analysis and presentation

Since this study employed the mixed methods research approach, there were data generated through both quantitative and qualitative techniques. The quantitative data were analyzed using descriptive and inferential statistical tools, whereas the qualitative data were analyzed thematically and then integrated with the quantitative one. It should be noted that the detailed analytical techniques employed are provided in each of the respective papers in the following chapters. As far as data presentation is concerned, based on the nature of data generated tables, figures, and graphs are used for the quantitative data, and the qualitative data are presented using narratives.

To ensure a better quality of the research output issues such as reliability, validity, and generalizability of the study were all seriously considered. According to Bryman (2012), these three are said to be the most prominent criteria for the evaluation of social research. First of all, before the actual field work was undertaken, the questionnaire developed was communicated with the supervisors of this study for verification, and then tested in the field so that potential misconceptions could be avoided in advance. Besides, the enumerators were also well oriented on the questionnaire (during the field test) so as to have the same level of understanding on the questionnaire. And lastly, the questionnaires were administered with close follow up to ensure reliability of data collected.

With regards to validity, variables selected for inclusion were based on suggestions by the supervisors, from empirical studies that appeared on reputable academic journals, and from other published materials. Similarly, concepts were also measured based on instruments which were widely validated and tested by scholars known in the respective areas. Again to ensure external validity of the findings, a standard formula for sample size determination and a probability sampling technique were also employed. Thus, since all the procedures followed in this study are discussed in detail, anyone interested can replicate the study.

1.6 Description of the Study Area

This study was conducted in Boset District, East Shewa Zone of Oromia National Regional State. According to information obtained from report of the zone's Finance and Economic Development Office (2011), East Shewa zone has 10 districts. Among those 10 districts, Boset is one of them in which Adama is the Zonal city of East Shewa.

1.6.1 Biophysical description of Boset district

Based on data obtained from Boset district Finance and Economic Development Office (2012), the district extends between $8^0$24'- $8^0$51' North latitude and $39^0$16'- $39^0$50' East longitude. It is bordered with Amhara National Regional State in the north, Fantale district in the northeast, Arsi zone in the east, Adama district in the south, and with Adama and Lume districts in the northwest.

The same document showed that Boset district is known to be located at the Rift Valley floor which is dominated by quaternary sediments that makes it conducive for farming activities and extraction of construction materials. However, it is highly influenced by the rift system, which is characterized by volcanic and tectonic activities. Nearly 89% of the district is below 1500 meters above sea level with the exception of the northwestern extreme parts where the highest relief feature is *Boset Guddo* with 2247 meters above sea level that gives the name for the district.

In terms of drainage system, Awash River is the significant river in the district. The river is source of irrigation for two state farms that produce fruit and vegetables. Besides, few residents who live on the flood plains of the river practice traditional irrigation to earn their living. Climatically most parts of Boset district (about 89%) belong to tropical (*kolla*) agro-climatic zone and the remaining small section (about 11%) is sub-tropical (*woina dega*). Average annual temperature varies between 25 – 30^0C for the tropical (*kolla*) and 15 – 20^0C for the sub-tropical (*woina dega*). The average annual rainfall ranges between 700 – 800 mm. In terms of vegetation cover, the district is endowed with coniferous forests of podcorpus variety which cover 671.88 km^2, followed by woodland and savannah of mixed deciduous that accounts for 375 km^2, and acacia trees cover 234.38 km^2 of the total land surface of the district. In addition, grasslands account for about 232.81km^2 of the total area.

1.6.2 Socio-economic setting of the district

Boset district is located 125 kms away from the capital, Addis Ababa. It undertakes its administrative tasks under 33 rural *kebeles* and four urban centers. The district uses Wolanchity town as its capital for administrative purposes, and has got two state farms, Nura Hera and Degage.

Based on the results of National Population and Housing Census of Ethiopia conducted in May 2007, a population projection was made for all Regions and Districts from 2014 – 2017. Accordingly, data obtained from CSA (2013) indicated that the total population of Boset district for the year 2017 was projected to be 189,795 out of which 42,793 (22.5%) are urban population and 147,002 (77.5%) are rural population.

With regards to age structure of the population residing in the district, according to a report from the district Finance and Economic Development Office (2012), those below 15 years old comprised 43%, those between 15 – 64 years constitute 51%, and the remaining ones who were above 64 years account for 6%. Thus, it can be learned that the dependency ratio in the district is about 49%. But since all those in the productive economic group could not be active due to various reasons, the dependency burden could be even more than what is indicated.

In terms of crude population density, the report obtained from the District's Finance and Economic Development Office (2012) indicated that for the year 2007, it was 93 persons per kilometer square and projected to be 111 persons per kilometer square for the year 2013. In the same report it was also indicated that agriculture was the mainstay of the residents in the district in which crop production and livestock rearing were practiced widely. In some parts of the district along the Awash River farmers were engaged in producing commercial crops like fruits and vegetables. When it comes to land use pattern, in the district 40,177 hectares of land were used for agriculture, 7,500 hectares were forest covered, 10,556 hectares were used for grazing land, and the remaining were identified to be under different purposes.

As far as infrastructure is concerned, Boset district had 87 kms all-weather and 305 kms of dry-weather roads; there was one post office in the district and about 12,556 people owned mobile phones; only 48.6% of the total population (both urban and rural) were reported to have access to potable water supply; in terms of sources of energy, firewood constituted the highest coverage of

energy supply followed by dung, charcoal and kerosene, respectively. Education facilities seem to be widely available particularly at the lower levels. In the year 2012, about 44 schools for levels 1-4; 32 schools for the levels 5-8; 3 schools for the levels 9-10; and only one preparatory school (11-12) were found in the district. With regards to health facilities and personnel, during the same year about 1 hospital, 7 health centers, 17 clinics and 33 health posts were found in the district. Similarly, there were 12 health officers, 40 nurses, 12 pharmacists, 12 laboratory technicians, 4 sanitarians and 66 community health workers. In fact, from the number of health facilities and professionals available, it can be understood how the health system was decentralized and to what extent prevention was given due emphasis. However, it was a bit paradox to have no medical doctor in a hospital where the distance from the big city, Adama, is so close. Following is the Map of Boset district that shows the sample *kebeles*.

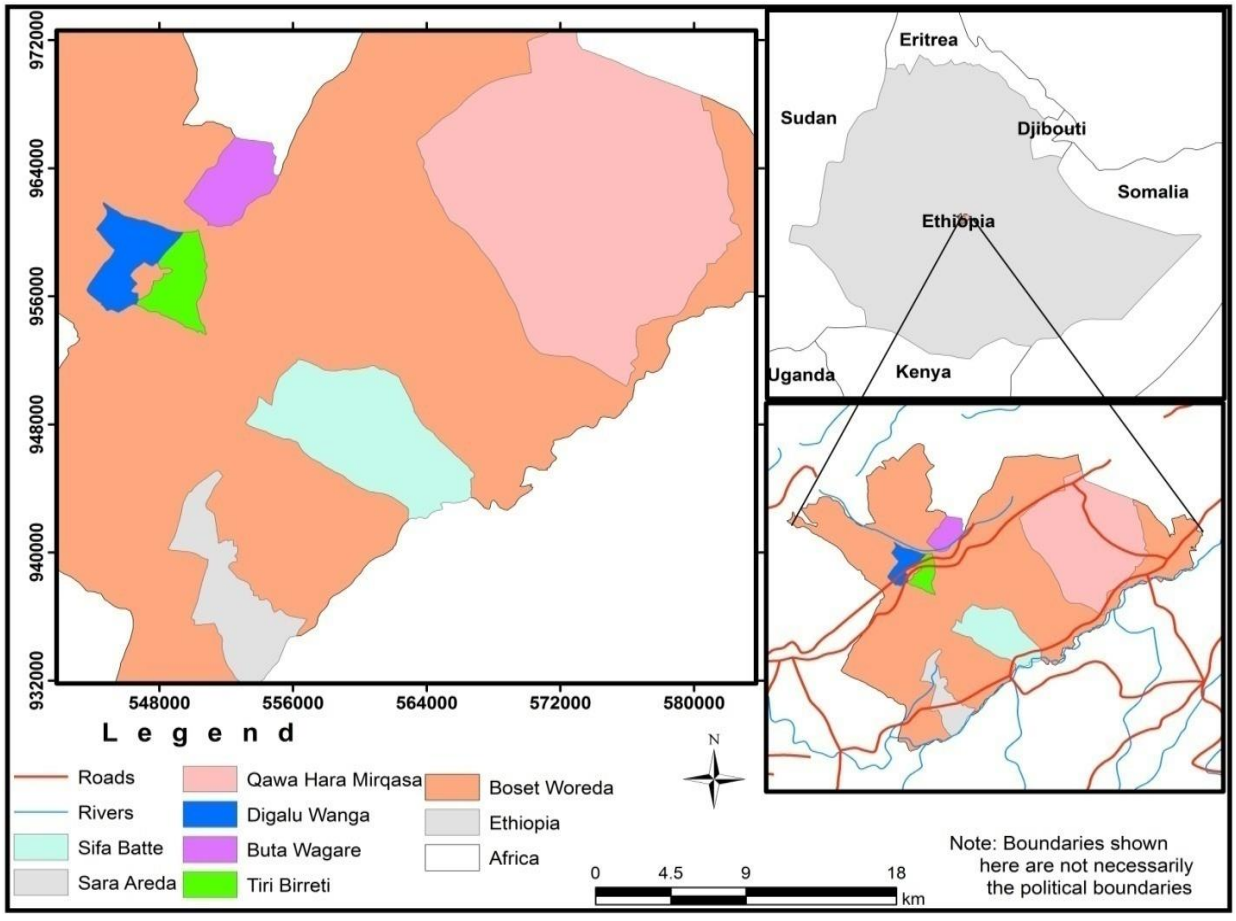

Figure 1.1 Location Map of Boset District

1.7 Significance of the Study

Food insecurity is a serious problem in Ethiopia since long time that made the country to be known as one of the most aid recipient countries in the world. This has been the case despite the different regimes' efforts to resolve the problem. The point now is that the lingering effects of food insecurity should be stopped at some point in time. Given this fact, it is possible to see the significance of this study from two angles, namely: with regards to knowledge, and the other in relation to practical contributions.

To begin with, multiple indicators were employed in this study to examine the food insecurity situation of the sample households. This could help to understand and explain the prevailing food insecurity situation in its multi-dimensionality with more confidence. In addition, the use of different theoretical underpinnings to explain the existing food insecurity may help in comprehending the complex nature of the food insecurity. Thus, researchers, concerned authorities at different levels, and partner NGOs could appreciate the benefits and apply the aforementioned approaches so as to have a better understanding of the existing reality. Of course, it is also hoped this study could add on the limited research findings on vulnerability as it relates to climate variability and food insecurity.

As far as the practical contribution is concerned, it can be started from the argument that authorities at different levels should no more blame drought as an excuse for their failure to protect the wider public. This is because drought is everywhere with little or even no consequence. Thus, the findings of this study could call the attention of decision-makers by challenging the view of the 'disaster narrative' as the prime cause of food insecurity. It appears that it is time to revisit the approach and/or development policy and strategy of the country so that a viable solution could be sought to stop this recurring problem. It was observed that there are various development strategies and policy documents that give priority in tackling food insecurity; nonetheless, the implementation of those directives on the ground is unsatisfactory.

Furthermore, this study advocates the vulnerability aspect of rural households across local contexts to be given due emphasis. This is because the vulnerability aspect could enable to address the root causes of food insecurity and also help to foresee the likely impact of the current practices. Another key contribution is that this study challenges the 'blanket approach' that comes down from above by highlighting some evidences, so that local contexts could be taken

for granted. In addition, those organizations working on food insecurity and climate variability are believed to have a better insight about the interaction of the variables of interest (i.e. elements of climate variability, components of vulnerability, and food insecurity) and then be informed on what to do about them.

1.8 Scope and Limitations of the Study

When conducting a research there is a need to delimit the scope of the study since it is difficult to cover everything and try to save the world with one go. Consequently, convenience in conducting the study, time frame, resource availability, and manageability were all taken into account when deciding the scope.

This study was conducted in Boset district of East Shewa Zone, Oromia National Regional State. This was made deliberate by looking into the food insecurity situation and the recurrence of drought in the area. Among the different variables of climate variability and change only issues pertinent to change in temperature, precipitation, and frequency of occurrence in extreme weather events as they trigger frequent drought and flooding were examined. Here, an attempt was made to see their effects on production, livelihoods, and consequently on the food insecurity situation together with the perception of households and the adaptation strategies pursued so far. With respect to vulnerability, all the three components (exposure, sensitivity and adaptive capacity) were treated taking into account the integrated vulnerability assessment approach. In addition, food insecurity situation of the study area was investigated as per the four dimensions through the use of a suite of indicators to have a comprehensive understanding of the situation. Finally, the underlying causes of the prevailing food insecurity were identified, and the roles of institutions (both formal and informal) were assessed to examine their effectiveness in dealing with problems of climate variability and food insecurity.

Nonetheless, various studies now have revealed that the impacts of climate variability and change are far-reaching, which may include health, economy, infrastructure, and even security. Moreover, climate change impacts will not manifest in isolation, but rather it could go beyond national and regional levels and could reach to a global level. However, all these are beyond the scope of this study. In addition, only pertinent policy documents and development plans of the EPRDF regime were considered for further scrutiny with the belief that thorough discussions

were made on the previous regimes with other scholars (see Mesfin, 1986; Markos, 1997; Degefa, 2005; Messay, 2012; Mulugeta, 2014).

As far as limitations of the study are concerned the first limitation appears to be its design. As the study is a cross-sectional survey, it is difficult to get adequate information on some time-sensitive issues, such as food insecurity and components of vulnerability. To this end, Barrette (2010) has stressed the need to develop food security measures based on longitudinal data. In fact, to overcome such shortcomings retrospective questions were employed in this study. Second limitation could be, as the study area has been under food aid for a long time, respondents attach everything with aid, i.e. when giving answers to some asset related questions there were tendencies to minimize their asset ownership. However, through probing, telling the real objectives of the study, and cross checking the same issue using different style of questioning the impact was minimized. Lastly, financial constraint is one critical problem encountered that inhibited a long stay in the field to generate adequate qualitative data.

1.9 Thesis Outline and Analytical Framework

1.9.1 Thesis Outline

The whole dissertation is composed of six chapters. Chapter One contains the general introduction of the study. Within this chapter an attempt is made to give general background information about food insecurity from the global to the study area levels; a brief description of the problem (food insecurity) together with the justification; the methodology pursued; a description of the study area; and significance of the study conducted.

The findings of the study are contained in the four papers coined as chapters 2 to 5. Chapter Two dwells on the analysis and discussion of the perceptions of respondents together with the manifestations of climate variability in the study area. Here, the practical experiences of the consequences suffered; the adaptation strategies pursued by respondents, the timing of adaptation actions and the barriers to adaptations are discussed. Next, Chapter Three deals with the determination of levels of vulnerability to food insecurity. Under this chapter the levels of vulnerability to food insecurity across the sample *kebeles* and gender are presented. In Chapter Four discussion of the food insecurity situation which was assessed through multiple indicators is presented. Then Chapter Five presents the analysis and discussion of the causes to food

insecurity and the roles played by both formal and informal institutions to correct the resulting problem.

Finally, it is in Chapter Six that summary is given, synthesis of the major findings, and conclusions derived. Here, the theoretical and methodological derivations of the findings are given so as to help comprehend the message of the overall research output. Besides, this chapter describes some of the important lessons learned from the study, discusses the policy implications, and suggests some important actions to be taken by different stakeholders so that the burdens of food insecurity could be lessened and livelihoods of the households' concerned improved for the better.

1.9.2 Analytical Framework

The analytical framework of this study as portrayed in Figure 1.2 (p. 30) shows the linkages between the variables that are composed of elements of climate variability, vulnerability, institutions and food insecurity. Following are a brief description of the variables considered in this study.

To start with, one may ask 'how do climate conditions relate to food (*in*)security?' To this end, scholars like Liverman and Kapadia (2010) have indicated that "food has always been linked to environmental conditions with production, storage and distribution, and markets all sensitive to weather extremes and climate fluctuations" (p. 3). This being the case, climate variability is taken in this study to refer to weather variations in the mean climate conditions, including variations in rainfall, temperature, and other weather events over space and time beyond a few days (Brown, 2016). In fact, variability may happen due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability) (IPCC, 2012).

Given the definition in the preceding paragraph and FAO's (2008b) document description, the elements of climate variability are comprised of increase in mean temperatures; gradual changes in precipitation (increase in frequency, duration and intensity of dry spells and droughts; changes in timing, location and amounts of rain); increase in frequency and intensity of extreme weather events (heavy rains, and flash floods); and greater climate variability (greater instability in seasonal weather patterns, change in start and end of growing seasons).

The impacts of climate variability and change on the food insecurity situation could be either direct or indirect (Ford & Furgal, 2009; Burke & Lobell, 2010; Tirado & Meerman, 2012). Ford and Furgal (2009) have elaborated that changing climatic conditions may increase the economic burden on harvesting (i.e., food access), disrupt store-food transportation networks (i.e., food availability), or affect household characteristics that determine the ability to produce, process, and share harvested food successfully and efficiently (i.e., food availability and access). Ford and Furgal added that there are also important temporal dimensions to climate change effects on exposure and sensitivity. The impact may involve sudden shocks; and equally, it may involve gradual change in climate-related conditions which slowly increase exposure and sensitivity over-time**.** In line with this argument, Burke and Lobell (2010) have also stressed that climate change will have potentially large effects on both agricultural yields and potential cropped area that could compromise the availability dimension of food security.

The second major variable which is considered in this study is vulnerability, which in turn is composed of indicators. Vulnerability is taken to mean both that households experience high risk of events that have adverse impacts on their livelihoods, and that their ability to deal with risky events when they occur is impaired (Ellis *et al.*, 2009). In other words, vulnerability refers the understanding of the extent to which one is prone, at risk, or likely to be food insecure (Thabane, 2015). Thus, vulnerability is a function of the character, magnitude, and rate of climate change and variation to which households are exposed, their sensitivity, and their adaptive capacity (IPCC, 2007).

Having recognized that vulnerability is composed of components which consists of exposure, sensitivity and adaptive capacity (Fussel & Klein, 2006; Smit & Wandel, 2006; Gbetibuou *et al.*, 2010), some have argued exposure and sensitivity are almost inseparable properties of a system (Smit & Wandel, 2006), and vulnerability could be understood as a hierarchical aggregation of these three components (Gbetibuou *et al.*, 2010).

In this study exposure is considered to refer to "the presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected" (IPCC, 2012, p. 559). In addition, sensitivity is taken as the degree to which households and their livelihoods are affected, either adversely or beneficially, by the elements of climate variability. As was mentioned in IPCC (2007) the effects

may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of extreme weather events).

Furthermore, adaptive capacity in this study is taken to refer to the combination of the strengths, attributes, and resources available to rural households and organizations that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities (IPCC, 2012). Taking into account the determinants, Opiyo *et al.* (2014) expressed adaptive capacity is explained by socio-economic indicators. In addition, Smit and Wandel (2006) also stated that adaptations are manifestations of adaptive capacity, and they represent ways of reducing vulnerability.

As the livelihood of rural households is exposed to high temperature, frequent drought and other extreme events, it affects their sensitivity (Awal *et al.*, 2016). However, the interaction of the exposure and sensitivity could produce potential impact (Metzger *et al.*, 2008) which will be mediated by adaptive capacity. Thus, depending on the adaptive capacity to moderate or offset the potential impacts, households are termed as less vulnerable, vulnerable, or highly vulnerable to food insecurity. From the discussions made so far, food insecurity could be taken as an outcome that resulted from the impacts of climate variability directly and/or from vulnerability of households to climate variability stimuli in an indirect way.

The other important components of the analytical framework are institutions. As can be seen in Figure 1.2, institutions have direct and indirect influences on the food insecurity situation of the households under investigation. As far as the direct influces of institutions is concerned, it can be observed that institutions could engage in direct support of households in need through, for instance, the PSNP in the Ethiopian context so that the food security situation could be improved.

With respect to the indirect influence of institutions, Zarafshani *et al.* (2016) have claimed that any institutional interventions tend to empower the adaptive capacity of farmers and thus enhance community resilience, that could enable them achieve food security. Thereby, any government intervention would act as a mitigation plan and would feedback to future shocks. According to Wreford *et al.* (2010) institutions (esp. formal) could enhance the adaptive capacity of households through the following three adaptation actions. First, by ***reducing the sensitivity*** of

households by investing, for instance, in flood defences or increased reservoir storage capacity; planting hardier crops that can withstand more climate variability; or ensuring that infrastructure in flood-prone areas is constructed to allow flooding. Second, by ***altering the exposure*** of a system to the effects of climate change, which can be achieved, for example, by investing in hazard preparedness and early warnings, such as seasonal forecasts and other anticipatory actions. Thirdly, by ***increasing the resilience*** of households, which can be achieved through generic actions which aim to conserve resources, but also include specific measures to enable specific populations to recover from loss. Similarly, institutions could again affect elements of climate variability in an indirect way when they are making households plant trees, construct terraces, and harvest water all these could moderate the weather and thereby contain the adverse effects of extreme weather events.

To sum up, based on the causal link that appear in the analytical framework and the descriptions given under this section, the food insecurity situation of households could be explained based on the three theoretical orientations discussed earlier. When extreme weather events are frequently happening, they could result in complete crop failure or reduced yield, which ends up into food insecurity. This direct effect of climate variability is what 'the climatic and environmental theories' expounded. The indirect effect of climate variability, on the other hand, gradually depletes households' resources by weakening their adaptive capacity making them more vulnerable. When households are unable to resist and recover from shocks due to resource depletion, there will be an increased vulnerability and increasing of the likelihood of chronic food insecurity. This phenomenon is what is explained by 'food insecurity as an outcome of vulnerable livelihood'. In the final analysis, one can see the role of institutions either directly or indirectly in enabling or constraining households to achieve food security. These active roles of institutions are what 'the political economy explanation' dwells on.

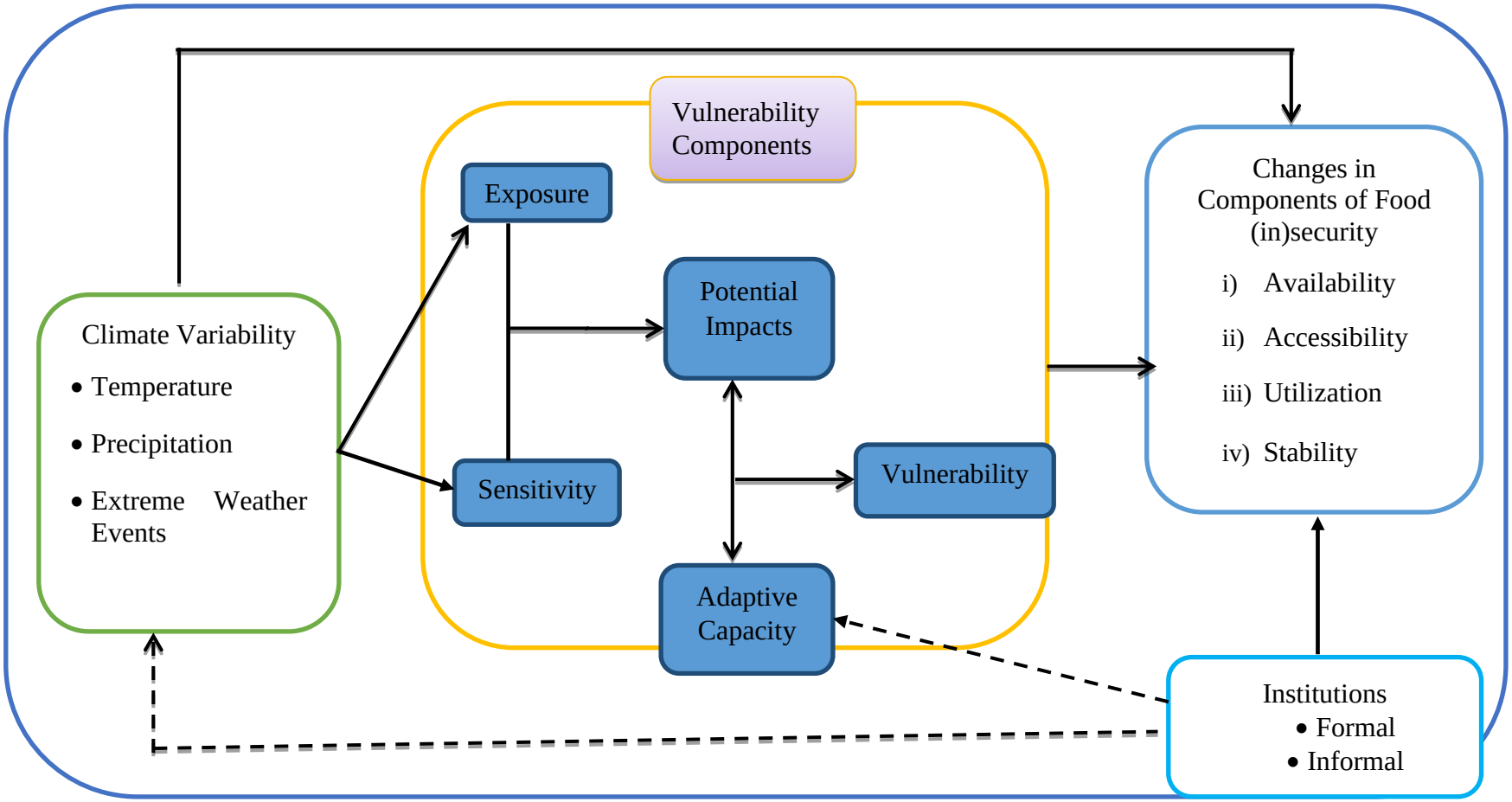

Figure 1.2 Analytical framework of vulnerability to food insecurity

Source: A framework modified from FAO (2008b) and Geronimo *et al.* (2013)

Note: The arrows show the linkages of the variables could be either direct influence (for the solid lines) or indirect influence (for the broken lines).

Chapter 2: Perception and Adaptation Strategies of Rural People against the Adverse Effects of Climate Variability

Abstract

This study explores the perception and adaptation strategies of rural households to the adverse effects of climate variability. To attain this objective two research questions were posed: i) how do rural households perceive and experience the effects of climate variability? and ii) what are the adaptation strategies of households for events of climate variability? We surveyed 397 heads of households selected through systematic random sampling. Additional data were generated from Key Informant Interviews, Focus Group Discussions, personal observations, and from meteorological data. The results revealed that an overwhelming majority (99.5%) of the respondents noticed changes in temperature which was also consistent with findings from the meteorological data; and 97.5% of the respondents again acknowledged changes in rainfall. As a consequence, households experienced reduced yield, complete crop failure, shortage of water both for people and animals, soil erosion, and destroyed assets. To offset such consequences, 91.5% of the households used an array of adaptation strategies including crop management related strategies, land management strategies, and diversification into non-farm activities. Nonetheless, the households were constrained by multiple barriers such as lack of finance (73.8%), shortage of land (60.7%), lack of water (48.9%), and lack of access to modern inputs (45.1%). Moreover, results from the multinomial logit model revealed gender, farmland size, total annual income, access to weather forecast, access to credit services, and distance to input/output markets have statistically significant effects on choice of adaptation strategies. Despite the wider awareness about climate variability, the multiple barriers to adaptation coupled with unmatched support from local authorities are complicating matters. Thus, it is suggested that more collaborative approach that acts in a proactive manner to overcome the adaptation barriers are needed so that efforts could be effective and pave the way to development.

Keywords: Adaptation strategies; Adverse effects; Climate variability; Perception; Rural Ethiopia.

2.1 Introduction

Climate is important for all living organisms (Pittock, 2009). However, with its dynamic nature that evolves over time come the concomitant problems of change (Gupta, 2009). Gupta (2009) expounded "…the climate change problem has evolved from an abstract, future, luxury problem to a concrete, urgent, and developmental problem" (p. 94). Similarly, it was commented by Westerhoff and Smit (2009) that the trend of climate change is becoming a serious global challenge, with far-reaching effects expected around the world. Here, the most worrisome issue is that "human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history" (IPCC, 2014), which can be said to have accentuated the magnitude and frequency of hazardous events (Wisner *et al.*, 2004).

Even though climate change is a worldwide concern, it is the smallholder farmers who are severely influenced due to their low adaptive capacity (Morton, 2007; Menike & Arachchi, 2016; Tripathi & Mishra, 2017). In similar way, Pachauri (2004), Yamin *et al.* (2005), and Ringler *et al.* (2010) also showed that the impacts of climate change fall disproportionately upon developing countries and the poor persons within all countries. More specifically, Ringler *et al.* (2010) and Woldeamlak (2012) illustrated that sub-Saharan Africa is expected to fare worst, given that temperatures are generally already high, and most of the region's inhabitants depend for their livelihoods on rain-fed agriculture.

The Ethiopian economy is highly dependent on agriculture, with 38.5% of Gross Domestic Product (GDP) and 80.2% of the population's earnings coming from this sector (National Planning Commission, 2016; Central Statistical Agency [CSA], 2013). Various studies show the country is highly vulnerable to climate variability and change that compromises the prospect for development (Conway & Schipper, 2011; Kassie *et al.*, 2014; Arragaw & Woldeamlak, 2016; 2017; Paul & Weinthal, 2018). The National Adaptation Program of Action (NAPA) for Ethiopia also confirms the vulnerability of Ethiopia to climate variability and change due to multiple causes (National Meteorological Agency, 2007).

Boset is one of the districts found in East Shewa zone of Oromia National Regional State, Ethiopia. This district was identified by the Regional Bureau of Agriculture and Rural Development as one of the most chronically food insecure districts in East Shewa zone due to frequent drought and unreliable rainfall. It lies in the midst of the Great Rift Valley which

extends from north to south of the district. The rural population that accounts for 77.5% (CSA, 2013) of the district derive their livelihood mainly from agricultural activities, which are sensitive to effects of climate variability. Based on information obtained from the district's Finance and Economic Development Office (2012) major problems in the district were identified and among them soil related sensitivity and climate aridity are the chief ones. In addition, an increased rate of resource degradation, salinity and clearance of vegetation cover coupled with bad agricultural practices and misuse/overuse of natural resources were also pervasive problems in the district. In terms of sources of energy, firewood constitutes the highest coverage of energy supply followed by dung, charcoal, and kerosene, respectively (Boset District Finance and Economic Development Office, 2012).

Before adaptation takes place, people need to have some awareness of whether their surrounding climate is changing or not (Tripathi & Mishra, 2017). To this end, scholars have argued for the need to know local people's perceptions of climate variability so as to facilitate the adaptation process and benefit from the adaptation itself (Woldeamlak & Dawit, 2011; Boissière *et al.*, 2013; Tiwari *et al.*, 2014; and Nega *et al.*, 2015). Furthermore, it is not only the changes in the surrounding climate that necessitate adaptation but also the perceived consequences are important factors. Though adaptation practice is not a new thing (IPCC, 2014), the current rate of change in the climate is so unprecedented that it is challenging human capability (Adger *et al.*, 2009). Hence, in order to overcome the adverse effects of climate variability and change community members are compelled to use different adaptation strategies.

With this regard, different studies have shown that households have been pursuing different adaptation strategies in order to overcome the problems which result from unusual climate variability and change (e.g. Howden *et al.*, 2007; Hassan & Nhemachena, 2008; Temesgen *et al.*, 2009; Aemro *et al.*, 2012; Adugna *et al.*, 2013; Belaineh *et al.*, 2013). However, in the process of taking adaptation actions there are different factors which determine the effectiveness of adaptation. These factors appear to influence the adaptation process in various directions and with different levels of significance (Hassan & Nhemachena, 2008; Temesgen *et al.*, 2009; and Negash, 2011).

Therefore, looking into impacts of climate change in the past and the expected change in the future, it is imperative to understand how farmers perceive climate change and adapt in order to

guide strategies for adaptation in the future (Bryan *et al.*, 2009; Adugna *et al.*, 2013). On one hand, the context- specific nature of adaptation (e.g. de Jalon *et al.*, 2014; IPCC, 2014) necessitates having more research. On the other hand, within Ethiopia, studies on this topic have so far focused more on the north and northwestern part along the Blue Nile Basin (e.g. Temesgen *et al.*, 2009; Dejene, 2011; Muluneh & Demeke, 2011; Woldeamlak & Dawit, 2011; Gebre *et al.*, 2015), and southeastern part of the country (Aemro *et al.*, 2012; Belaineh *et al.*, 2013; Yibekal, *et al.*, 2013; Dirriba & Jemma, 2015). Thus, to fill the gaps highlighted, the focus of this paper is in the central part of Ethiopia that is prone to frequent drought and has not received much research coverage.

This paper aims to understand the perception and adaptation strategies of rural households to the adverse effects of climate variability. Through survey, key informant interviews, focus group discussion, and informal discussion, this study examines (i) the perceived impacts of climate variability, and (ii) the adaptation strategies of households to the events of climate variability. The findings of the study could provide context-specific inputs for policy makers and generate useful insights for comprehending the underlying factors for effective adaptation.

2.2 Materials and Methods

2.2.1 Description of the study area

Boset district extends between $8^0$24'- $8^0$51' North latitude and $39^0$16'- $39^0$50' East longitude. It is located in the northeast part of East Shewa zone. It is bordered with Adama district in the west and southwest; Amhara National Regional State in the north and northwest; Fantale district in northeast, and Arsi zone in south and southeast. Based on the results of National Population and Housing Census of Ethiopia conducted in May 2007, a population projection was made for all Regions and Districts from 2014 – 2017. Accordingly, data obtained from CSA (2013) indicated that the total population of Boset district for the year 2017 was projected to be 189,795 out of which 42,793 (22.5%) are urban population and 147,002 (77.5%) are rural population.

According to information obtained from Boset District Finance and Economic Development Office (2012), the district is located in the midst of the Great Rift Valley, which extends from the North to South of the district. Climatically most parts of the district (about 89%) belong to tropical (*kolla*) agro-climatic zone and the remaining small section (about 11%) is sub-tropical

(*woina dega*). The district is characterized by hot and dry weather with an average annual temperature which varies between 25 – 30^0C for the tropical (*kolla*) and 15 – 20^0C for the sub-tropical (*woina dega*). The rainfall is weakly bi-modal with a small rainy season in spring during the months of April and May while a long rainy season in the summer during the months of July to September. The average annual rainfall ranges between 700 – 800 mm with the intensity and variability being high in the district. In terms of drainage system, the district falls in the Awash River Basin, with no other major streams and lakes. As a result, there are acute water problems for livestock and people.

2.2.2 Data collection

This study is conducted in Boset District in East Shewa zone of Oromia National Regional State. The district was chosen as the study area because it was identified by the Regional Agriculture and Rural Development Bureau as one of the most food insecure districts. Besides, the district being identified as drought prone area and relative proximity of the district to Addis Ababa served as additional reasons for selection.

The study was undertaken as a cross-sectional survey using mixed methods research approach. The choice of mixed methods was dictated by the research problem under investigation and to benefit from the merits of using this research approach (see e.g. Creswell, 2009, 2012; Creswell & Clark, 2011). The convergent parallel design was preferred for this study, in which, according to Creswell & Clark (2011), quantitative and qualitative data are collected and analyzed side by side; results compared or related, then followed by interpretation of the overall results.

In terms of sources of data, both primary and secondary sources were utilized. The primary data were generated by employing household survey which was administered by 12 Development Agents (DAs[4]) who are familiar to the study area and conversant with the local language (Afan Oromo). After pretesting and fully developing the structured questionnaire, it was administered face-to-face. Key informant interviews (KIIs) were also held with heads of offices and focal persons from health, women's and children's affairs, water resources, irrigation, crop production, livestock production, natural resources management, disaster preparedness and prevention, World Vision Ethiopia (Boset Area Development Program), and community elders living in the

[4] Development Agents (DAs) are those individuals trained in agriculture colleges for three years in areas of crop production, animal health, and natural resources management to promote the agricultural extension program.

sample *kebeles*[5]. The key informants were those individuals thought to be knowledgeable about climate variability because of the position they assume and those who lived for a very long year in the district.

Similarly, focus group discussions (FGDs) with selected 6 men's and 4 women's groups were conducted, in the sample *kebeles*, separately with members comprising 6-10 individuals. The groups were formed on volunteer basis with the help of the DAs working in the respective sample *kebeles*. The criteria for inclusion in the group discussions were household heads lived in the *kebele* for more than 5 years and some knowledge on climate variability issues. Lastly, personal observations coupled with informal discussions were also employed to generate primary qualitative data.

As secondary sources, information was supplemented by using current and relevant academic journal articles, books, reports, and official documents. Besides, we have also used meteorological data from two weather stations as sources of secondary data to validate households' perception of the elements of climate variability.

To have a full picture of the district, a total of 6 *kebeles* located at different places were selected by district level experts. Food insecurity status, access to irrigation facilities, and participation in the Productive Safety Net Program (PSNP) were used as criteria for selecting the sample *kebeles*. The PSNP was used as one criterion to get those *kebeles* which are chronically food insecure, this is because it is only 10 *kebeles* of the district under the PSNP. Otherwise, it was not the intension of this study to assess the impacts of PSNP.

List of households living in each of the selected *kebeles* was taken as a sampling frame, then respondents were selected using systematic random sampling technique proportionate to the size of households living in each *kebele*. Systematic random sampling technique was employed because it is one of the probability sampling methods and is easy to manipulate during selection of the sample households (Babbie, 2008; Bryman, 2012). Using the formula developed by Yamane (1967) as cited in Israel (2013), the sample size was calculated which resulted in a total of 397 participants (48 female- and 349 male-headed households). In the determination of the sample size, a 95% confidence level and a *p*-value of .05 for maximum variability were assumed.

[5] A *Kebele* is the lowest community level administrative organ consisting of a number of villages.

2.2.3 Data analysis

Based on the nature of the variables measured, to analyze the data collected through the survey both descriptive and inferential statistics were employed. Accordingly, to measure perception about climate variability, the perceived consequences, and the barriers to adaptation we have mainly used percentages, mean, and standard deviation. The final analysis of the quantitative data was done using STATA v.12.

Results from FGDs, KIIs, and the field observations were transcribed and analyzed according to themes (e.g. manifestations of climate variability, their patterns, consequences of extreme weather events, barriers to adaptation).

To identify the determinants of adaptation strategies, we employed the multinomial logit model (MNL) which is commonly employed in this field (Temesgen *et al.*, 2009; Armah *et al.*, 2013). Temesgen *et al.* (2009) stated that the MNL model is more suitable to the analysis of decisions across more than two categories, allowing the determination of choice probabilities for different categories and is also computationally simple. In addition, the computational burden of the MNL specification is made easier by its likelihood function, which is globally concave (Hausman and McFadden, 1984 cited in Adugna *et al.*, 2013); and the model also exhibits superior ability to predict discrete choices (Belaineh *et al.*, 2013). In relation to this model, to test for any multicollinearity problems among independent variables both the variance inflation factor and tolerance were applied.

Specification of the econometric model

To describe the MNL model, let y denote a random variable taking on the values {1, 2, . . ., J} for J, a positive integer, and let x denote a set of conditioning variables. In this case, y denotes adaptation options or categories and x contain different household and institutional attributes.

The MNL model for the adaptation choice specifies the following relationship between the probability of choosing option y_i and the set of conditioning variables x as follows:

$$P(y_i = j) = \frac{e^{\beta'_j x_i}}{\sum_{k=0}^{j} e^{\beta' x_i}} = 0, 1, 2, \dots j \qquad (2.1)$$

where β_j' is a vector of coefficients on each of the independent variables x. Equation (2.1) can be normalized to remove indeterminancy in the model by assuming that $\beta_0 = 0$ and the probabilities can be estimated as:

$$\mathrm{P}(\mathrm{y_i} = \mathrm{j}/x_i) = \frac{e^{\beta' x_i}}{1+\sum_{k=1}^{J} e^{\beta' x_i}}, \mathrm{j} = 0,1,2, \ldots \mathrm{J}, \beta_0 = 0 \qquad (2.2)$$

Estimating Equation (2.2) yields the J log-odds ratios

$$\ln\left(\frac{\mathrm{p_{ij}}}{\mathrm{p_{ik}}}\right) = x_i'(\beta_j - \beta_k) = x_i'\beta_j, \qquad if\ k = 0$$

The dependent variable is therefore the log of one alternative relative to the base alternative (Aemro et al., 2012). According to Temesgen et al. (2009) the parameter estimates of the MNL model provide only the direction of the effect of the independent variables on the dependent (response) variable, but estimates do not represent either the actual magnitude of change nor probabilities. Thus, differentiating Eq. (2.2) with respect to the explanatory variables provides marginal effects of the explanatory variables given as:

$$\frac{\partial \mathrm{p_j}}{\partial x_\mathrm{i}} = p_j(\beta_j - \sum_{k=o}^{J} p_k \beta_k) = p_j(\beta_j - \bar{\beta}) \qquad (2.3)$$

The marginal effects or marginal probabilities are functions of the probability itself and measure the expected change in probability of a particular choice being made with respect to a unit change in an independent variable from the mean (Green, 2000 cited in Temesgen *et al.*, 2009).

Description of the variables employed

The explanatory variables hypothesized to have associations with the households' adaptation strategies were identified based on a review of literature and availability of data. These variables constitute socio-economic attributes of households (age, gender, family size, educational level, farm experience, total income, farm size); and institutional factors (access to DA services, access to credit, distance from input/output markets, and access to weather forecasts). The hypothesized effects of the independent variables against the adaptation strategies are given in Table 2.1.

Table 2.1 Variables hypothesized to affect adaptation strategies by households in the study area

Explanatory variables	Description	Expected sign
Age of the household head in years	Continuous	+/-
Gender of the household head	Dummy takes the value of 1 if male and zero otherwise	+
Educational level of the household head	Dummy takes the value of 1 if formal education and zero otherwise	+
Household size – number of members in a household	Descete	+/-
Farm experience – Farming experience of the household head in years	Continuous	+/-
Annual income of the household	Continuous	+
Farm size in hectares	Continuous	+
Access to agri. extension services	Dummy takes the value of 1 if there is access and zero otherwise	+
Access to credit services	Dummy takes the value 1 if there is access and zero otherwise	+
Access to weather forecast	Dummy takes the value 1 if there is access and zero otherwise	+
Distance from input/output market in walking hours	Continuous	-

2.3 Results and Discussions

2.3.1 Perception of climate variability and change

The perception of rural households of prevailing climate variability and change is important as it can significantly influence their readiness and capacity to develop strategies. Table 2.2 shows 99.5% of households had noticed change in temperature over the last 5-10 years. In addition, a significant number of the households (97.5%) have perceived more changes in rainfall over the last 5-10 years.

Table 2.2 Noticed changes in temperature and rainfall over the last 5-10 years

Manifestations of climate variability	Responses				Total	
	Yes		No			
	n	%	*n*	%	*n*	%
Temperature change	395	99.5	2	0.5	397	100.0
Rainfall change	387	97.5	10	2.5	397	100.0

In addition to perceiving the change in climate in the area, knowing the pattern of those changes could be beneficial as it could prompt adaptation action. About 80% of the respondents

witnessed an increase in temperature, whereas 17.2% and 2.8% of the households claimed to have seen fluctuation and decrease of temperature, respectively (Figure 2.1).

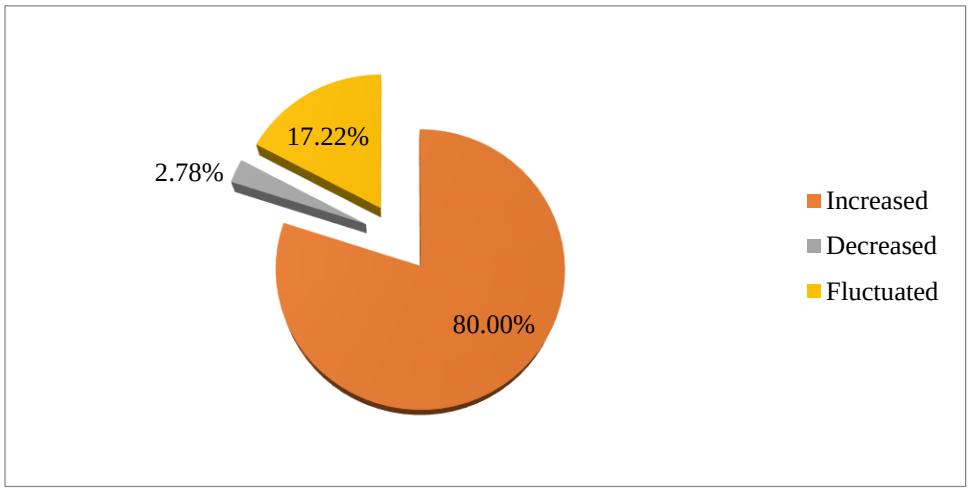

Figure 2.1 Patterns of temperature change

As far as change in rainfall pattern is concerned, it can be seen from Table 2.3 that among the valid responses only 2.1% of the respondents replied to have observed rainfall pattern coming late with high intensities. The remaining respondents replied, the rain coming late with dry spells (66.4%), coming late and ending early (65.6%), and an overall shortage of rainfall (62.8%).

Table 2.3 Patterns of rainfall (Multiple responses)

Rainfall patterns	Responses		Percent of Cases*
	n	Percent	
Comes late and ends early	256	33.3	65.6
Comes late with dry spells	259	33.7	66.4
Overall shortage of rainfall	245	31.9	62.8
Comes late and with high intensities	8	1.0	2.1
Total	768	100.0	196.9

*Percentages do not add up to 100 because of multiple responses.

It can be observed that inadequacy of rainfall and unreliability of the raining time could characterize the study area. Hence, it could be inferred that agricultural practices could be highly constrained and solutions should be sought in line with this constraint.

Findings on perception from KIIs and FGDs have also revealed an increasing trend of temperature witnessed by all of the participants. But as far as rainfall patterns are concerned,

there were key informants and discussants who claimed to have observed a decreasing trend, on one hand. And, there were others who argued there have been shortage of rainfall in the district and in their respective *kebeles*, what is new, maybe is the unpredictability of the timing of rain, on the other hand.

But before coming to conclude on the perceived changes in temperature and rainfall, and to see the consistency of perceptions with meteorological data, a comparison was made between them. To do this, meteorological data were obtained from Adama and Nura Era weather stations through the National Meteorological Agency for the years 2006-2015. These two weather stations were used to get a proxy data so that a full picture of the district could be obtained.

Findings from the two weather stations showed an increase in the maximum temperature. The maximum temperature is generally higher in Nura Era compared to Adama. When the temperature data from the weather stations are compared to the perceptions of respondents, the findings are consistent, i.e. as is claimed by the respondents and confirmed by the meteorological data, the maximum temperature has increased over the years 2006-2015. In contrast, results of the weather stations show there has been no clear increasing or decreasing trend in precipitation over the last 10 years. In fact, least amount of rain was recorded for the years 2014 and 2015 in Nura Era and for 2015 in Adama. Thus, observed precipitation is not consistent with respondents' observations on rainfall.

Our findings contradict with some other studies which have found an agreement between perceived decreasing rainfall amount and shorter rainy seasons (e.g. Maddison, 2007; Gbetibouo, 2009; Nega *et al.*, 2015; Limantol *et al.*, 2016). However, in terms of temperature, there are many studies which attested the increasing trend of the temperature in line with respondents perceptions (e.g. Gbetibouo, 2009; Temesgen *et al.*, 2009; Muluneh & Demeke, 2011; Woldeamlak & Dawit, 2011; Belaineh *et al.*, 2013; Okonya *et al.*, 2013; Sahu & Mishra, 2013; Nega *et al.*, 2015; Limantol *et al.*, 2016).

From the findings discussed in the preceding paragraphs it should be noted that both increase in temperature and unreliability of rainfall amount could pose big challenges especially for the rural households who highly depend on rain-fed agriculture. Thus, these two climate variability elements should be a point of concern for those who are working to improve the wellbeing of the population in the study area.

2.3.2 Perceived consequences of climate variability

Climate variability and change could impose heavy burden on the poorer people of the developing countries. Cognizant of this fact, households were requested to name the natural disasters they encountered and identified both drought (*n*=369) and flood (*n*=28). Hence, the negative consequences of climate variability can be manifested through the occurrence of extreme weather events, i.e. drought and flooding in relation to the study area.

With respect to the occurrence of extreme weather events, results of our study finding shows large number of respondents that account for 88.9% (*n*=353) of them witnessed drought occurrence (Table 2.4). Here respondents pick a drought year when they encountered extreme shortage of precipitation and their crops failed to grow. Whereas about 11.1% (*n*= 44) of the remaining respondents did not see something different in drought occurrence compared to the last 5-10 years. Given that the *p*-value which is very small (*p*<1%) and with 5 degrees of freedom, one can see there is a statistically significant difference in noticing changes of drought occurrence across the sample *kebeles*.

Table 2.4 Noticed changes in drought compared to the last 5-10 years

Name of *kebele*	Responses				Total	
	No		Yes			
	n	%	*n*	%	*n*	%
Buta Wagare	9	20.5	12	3.4	21	5.3
D/Wanga	15	34.1	15	4.3	30	7.6
Q/H/Mirqasa	1	2.3	159	45.0	160	40.3
Sara Areda	17	38.6	35	9.9	52	13.1
Sifa Batte	0	0.0	108	30.6	108	27.2
Tiri Birreti	2	4.5	24	6.8	26	6.5
Total	44	100.0	353	100.0	397	100.0

Pearson chi2 (5) = 123.7813 Pr=0.000

Of course, this disproportionately high number of respondents noticing drought occurrence signifies that climate variability is indeed manifesting itself in the study area and consequently the members of the rural communities could be prone to the vagaries of drought.

However, it is not only the occurrences of the extreme weather events per se that concerns, but the frequency of occurrence is what matters most. To this end, results show drought has occurred

three times on average, whereas flood has occurred twice on average over the last ten years (Table 2.5).

Table 2.5 Drought and flood frequencies in the last 10 years

Variable	*n*	Mean	Std. Dev.	Min	Max
Drought frequency	353	2. 912181	.8631957	1	6
Flood frequency	98	2.295918	.9105248	1	5

The finding on drought frequency is in line with what was found during key informant interview and focus group discussions in the study area. The participants mentioned drought mainly occurs approximately within 3-4 years. Particularly, one key informant from *Butta Wagare kebele* expressed that the dry season is getting elongated reaching up to 8 months per year. In addition, the same person told drought is occurring once in four years. In line with this, the district head of Disaster Preparedness and Prevention office identified 2000/01, 2004/05, 2008/09, and 2014/15 as the years in which the residents of the district faced severe drought. Both local authorities and respondents view a drought year taking crop failure and shortage of rainwater (precipitation) in that given year as indicators, which make the results more or less comparable. Besides, all the key informant interviewees and focus group discussants agreed that drought occurs more frequently than previous dates due to deforestation being the prime aggravating factor. A similar finding is, in fact, reported by Gebreyesus *et al.* (2016) that deforestation is the main cause of climate variability.

With respect to problems faced due to drought, the households identified a number of problems. The finding shows reduced yields (82%), complete crop failures (61.6%), and shortage of water both for animals and people (44.2%) to be the three main problems encountered by residents of the study area due to drought (see Table 2.6).

Table 2.6 Problems faced due to drought (Multiple responses)

	Responses		Percent of
Problems of drought	*n*	Percent	Cases
Complete crop failure	223	29.5	61.6
Reduced yields	297	39.3	82.0
Diseases/health problems/ sickness has increased	76	10.1	21.0
Shortage of water both for animals and people	160	21.2	44.2
Total	756	100.0	208.8

As results of Table 2.6 reveal, all of the consequences (i.e. reduced yields, complete crop failure, shortage of water, and increased health problems), have a strong negative implication on the food security situation of people in the study area.

To ascertain whether there exist other similar findings, comparison of findings was made. Then, we found that, due to the fact that some crops are near their maximum temperature tolerance, and where non-irrigation dominates, yields are likely to decrease with even small increase in atmospheric temperature (CGIAR 2005 cited in Sofoluwe *et al.*, 2011). To make matters worse, a reduction in crop productivity is usually resulted to less income for farmers, hunger, increased prices for food, unemployment, and migration (Sivakumar *et al.*, 2014). This shows how the consequences faced by the households could have far-reaching effects.

The other extreme weather event which was considered in this study is flood occurrence. Results on this event show only 24.7% (*n*=98) of the households witnessed the occurrence of flood in the last 5-10 years, while the remaining households which account for 75.3% (*n*=299) replied they did not notice flood occurrence in their locality.

Even though the proportion of respondents who confronted with flood occurrence were small, those who experienced reported soil erosion (80.4%), reduced yield (66.7%), and destruction of assets (51.4%) as the top three identified problems of flooding (Table 2.7).

Table 2.7 Problems respondents encountered due to flooding (Multiple response)

Problems of flooding	Responses		Percent of
	n	Percent	Cases
Rotting of tuber and roots	35	10.2	25.4
Increased fungal diseases	5	1.4	3.6
Reduced yield	92	26. 7	66.7
Soil erosion	96	27.8	80.4
Reduced farmland	30	8. 7	21.7
Destroyed food stores	16	4.6	11.6
Destruction of assets (like farm equipment)	71	20.6	51.4
Total	345	100.0	260.9

A closer look at the actual consequences of drought and flood show a strong tie with food security matters. Thus, results imply food security and even future livelihood of the rural population could be at stake unless these two extreme weather events are tackled effectively. Of course, studies conducted in different parts of Ethiopia have come up with similar findings that erratic nature of the rain and frequent drought have resulted in decreases in crop production and increasing food deficits (Wodeamlak, 2012; Chemonics International Inc., 2015; Arragaw & Wodeamlak, 2016).

2.3.3 Adaptation strategies and their determinants

Households were found to have employed different kinds of adaptation strategies to overcome the problems emanating from frequent occurrence of the extreme weather events. These were comprised of changing planting dates, using different crop varieties, adopting drought resistant crops, increased use of fertilizer, increased use of soil and water conservation techniques, water harvesting, planting trees, increased use of irrigation, and diversification into non-farm activities. Of course, these adaptation strategies employed so far were broadly categorized into three commonly cited adaptation options for the sake of convenience when analyzing the determinants. In addition, it is because any of the adaptation strategies are mostly followed in combination with other strategies and not alone (Hassan & Nhemachena, 2008). In the process of doing this, changing planting dates is dropped from the analysis after looking that this adaptation strategy is exercised by almost all of the respondents, in which its inclusion may not bring any new insight.

The dependent variables specified for this study are thus the choices of adaptation strategies from the set of adaptation measures. Thereby, crop management related strategies (which include using different crop varieties, adopting drought resistant crops, increased use of fertilizer); land management related strategies (consisting increased use of soil and water conservation techniques, water harvesting, planting trees, increased use of irrigation); and, diversification into non-farm activities (which comprise selling local drinks, petty trading, making handicrafts, and selling forest products such as charcoal and firewood) are the adaptation options exercised. In addition, no adaptation strategy is considered as the base category and the remaining choices as alternative options for the analysis purpose.

The following are presentation of the discussions for determinants of the adaptation strategies which are obtained from the MNL model (Table 2.8). The discussions here focused only on the independent variables with statistical significance ranging from a *p*-value of 1% to 10% significance levels.

Gender

Gender of household heads, i.e. being male was hypothesized to be positively associated with decisions about adaptation strategies. But our finding shows a mixed result as far as gender is concerned. The result from the MNL model shows being male is associated with 17.1% more likelihood of opting for land management related adaptation strategies at $p<0.1$ significance level. This could be because "much of the farming activities are done by the male while the females are more involved in the processing" (Aemro *et al.*, 2012, p. 6). Whereas, in choosing diversification into non-farm activities, men are 15.0% less likely to choose it at $p<0.01$ significance level. This result could imply interventions that are meant to facilitate adaptation strategies should take care of the gender aspect to be more effective.

Farmland size

It was assumed that households with larger farmland size could use different adaptation strategies to abate the adverse effects of climate variability. But the finding shows mixed results across the different adaptation strategies. A unit increase in farmland size increases the probability of adopting land management related adaptation strategies by 6.4% at $p<0.05$ level of significance. But in relation to diversification into non-farm activities, a one unit increase in farmland size is associated with a 3.5% decline in choosing it by households at $p<0.1$ level of significance. This result may signify that whenever households are getting more farmland they prefer to engage in farm related activities that increases their farm quality and thereby productivity. A comparison with other empirical studies (e.g. Adugna *et al.*, 2013) shows a contrasting result. Adugna *et al.* (2013) have found an increasing farmland size by 1 unit decreases the probabilities of using soil and water conservation by 48%. Hence, it could be learned that adaptation strategy is context specific that we should be vigilant of a blanket approach.

Access to weather forecast

It was hypothesized that households with better access to weather forecast can apply the adaptation strategies which suit them according to the information they obtain. The result shows, in line with our expectation those households with more access to weather forecast were 53.8% more likely to choose crop management related adaptation strategies at $p<0.01$ significance level. However, when it comes to opting for land management related adaptation strategies, households with more access to weather forecast were 27.6% less likely to choose it at $p<0.1$ significance level. The result on crop management strategies may imply that more information on weather forecast boosts farmers' confidence to invest more when the climate is favorable. Thus, this result begs the attention of similar areas that want to increase crop production and productivity.

Total annual income

Total annual income of households was found to have a strong statistical significant effect across the three categories of the adaptation strategies at $p<0.01$ compared to those who were not adapting at all. But a closer look at the finding shows an increase in total annual income increases the likelihood of choosing land management related strategies and diversification into non-farm activities with very minimum amount, which was less than 1%. Similar to this finding, Yibekal *et al.* (2013) have also found income to be positively related with adaptation either by tree planting alone or by employing additional measures. In contrast, our finding shows total annual income increase was associated with less likelihood of opting for crop management related strategies, though the effect is very much minimal. It can be deducted that ways should be sought to increase the total annual income as this helps to undertake land management adaptation strategies which could have a long-term positive impact and enable diversification more which is less climate sensitive (except for the use of forest products).

Access to credit service

In terms of access to credit households with better access were found to be 13.2% less likely to choose crop management related adaptation strategies at $p<0.05$ significance level. This tendency could be because households may prefer to fill food gap which resulted from frequent drought with the money they borrowed. In a similar vein, Armah *et al.* (2013) have justified that farmers who borrow money either use it to meet instantaneous consumption needs or invest in

other off-farm activities due to risk of reduced productivity on their farms. On the other hand, in choosing diversification into non-farm activities, households with more access to credit services were 8.3% more likely to choose it at $p<0.05$ significance level. Notwithstanding the contextual nature of adaptation strategies, we have found better access to credit service associated negatively with crop management strategies, whereas other studies (like Hassan & Nhemachena, 2008; Adugna *et al.*, 2013) found positive association, this may signify the need to look into the underlying causes of such differences.

Distance to input/outputs market

In this study it was found that more distance from input/output markets is associated with more likelihood of opting for crop management related strategies and land management related strategies, at $p< 0.05$ and $p<0.1$ significance level, respectively. This could be because as the distance increases from the market places adaptation through the options available becomes a *must* as households do not have other options to fall back on. Besides, the positive relationship could imply that respondents may use other mechanisms that substitute market services and also rely on locally available resources. As was hypothesized in this study, farther distance from input/output markets was associated with a 12.1% less likelihood of choosing diversification into non-farm activities at $p<0.01$ significance level. This inverse relation could be partly because diversification into non-farm activities involves engaging primarily in market oriented undertakings, i.e. people will opt for diversification to get immediate gain from their activities which requires proximity to marketplaces.

A comparison of our finding, with respect to distance from input/outputs market, with other studies show mixed results. For example, like what was found in our study, positive association of crop management and land management related strategies were also observed by other studies like Hassan and Nhemachena (2008), Yibekal *et al.* (2013), and Dirriba and Jema (2015). And contrary to our finding, there are other studies which found increase in distance to market center would reduce the probability of adoption of soil and water conservation and crop variety selection strategy (like Aemro *et al.*, 2012; Adugna *et al.*, 2013). This mix of results across different studies still show how much choice of adaptation options is context specific.

Findings of the MNL model together with the marginal effects in Table 2.8 revealed that some of the independent variables do not have similar level of effects across the adaptation strategies.

Again, it can be seen among those variables which have statistically significant effect, only total annual income of households and distance to input/outputs markets were the variables found across the three categories of the adaptation strategies. In addition, age of household head, educational status, household size, and access to agricultual extension services were found to have no statistical significant effect in the choice of adaptation strategies. Hence, for the sake of efficiency and effectiveness, it will be wise to take into account those variables with significant effect when planning to make use of the meager resources for adaptation.

To sum up, from the foregoing discussions it can be observed that the decision to take adaptation actions could be affected by the different explanatory variables at varying significance levels. Comparisons made between findings of this study and other empirical studies also show some results corroborate with what we have found, and other findings diverge from ours. Hence, efforts on adaptation strategies should consider seriously the nature of the adaptation strategies vis-à-vis the context where the adaptation is to take place.

Table 2.8 Parameter estimates of the multinomial logit climate change adaptation model with their marginal effects

Explanatory variables	Crop management related strategy			Land management related strategy			Diversification into non-farm activities		
	Coefficients	P value	Marginal effect	Coefficients	P value	Marginal effect	Coefficients	P value	Marginal effect
Gender	-0.1575369	0.692	-0.0284495	0.4000884	0.036	0.1709418**	-1.184732	0.001	-0.1502455***
Age	0.0117722	0.581	-0.0014095	0.0254716	0.206	0.0033731	0.0073067	0.588	-0.0011394
Educational status	0.0076552	0.392	-0.0416454	0.2291441	0.549	0.0306657	0.2881948	0.612	0.0195632
Household size	0.2525017	0.111	0.0184619	0.1529742	0.294	-0.0132604	0.2169207	0.631	0.0045677
Farmland size	-0.207555	0.186	-0.0335615	0.0780587	0.013	0.0637019**	-0.3595002	0.088	-0.035863*
Total annual income	-5.73E-06	0.000	-0.0000235***	0.0001257	0.000	0.0000197***	0.0001305	0.001	8.04E-06***
Access to weather forecast	5.277415	0.006	0.5379351***	2.693545	0.067	-0.2760144*	2.643988	0.208	-0.0913518
Access to agri. extension service	-0.157071	0.539	0.0351473	-0.5288247	0.102	-0.0948378	0.0860117	0.320	0.046738
Access to credit service	-1.563288	0.014	-0.1315949**	-1.124155	0.929	-0.0048435	-0.4562954	0.025	0.0826577**
Distance to input/output market	1.098311	0.034	0.0822577**	1.019616	0.059	0.0759547*	-0.114749	0.000	-0.1205836***
Constant	-4.76817			-4.761665			-2.865629		
Base category	No adaptation								
Number of observations	397								
LR Chi-Square (30)	181.09								
Log Likelihood	Log likelihood = -395.18894								
Pseudo R-Square	0.1864								

***,**,* Significant at 1%, 5%, and 10% probability level, respectively.

It was illustrated by different scholars like Ziervogel *et al.* (2006) and organizations such as FAO (2016b) that seasonal forecast information feeds into the adaptation strategies so that farmers could be in a better position to adapt to foreseeable variations in climate. Cognizant of such benefits, respondents were inquired to confirm their access to weather forecast and results show 91.7% have access to weather forecast related information and the remaining 8.3% did not (see Table 2.9).

Table 2.9 Access to weather forecast

Weather forecast	Responses	
	n	Percent
Yes	364	91.7
No	33	8.3
Total	397	100.0

In fact, such a significant number of respondents having access to weather forecast may imply respondents are in a better position to take adaptation actions, notwithstanding other determining factors.

Futhermore, those households who claimed to have access to weather forecast also identified their sources of information. Thereby, the finding from Figure 2.2 shows respondents were getting information from multiple sources, like radio/television (78.0%), use of traditional knowledge (56.6%), and from Development Agents (54.7%).

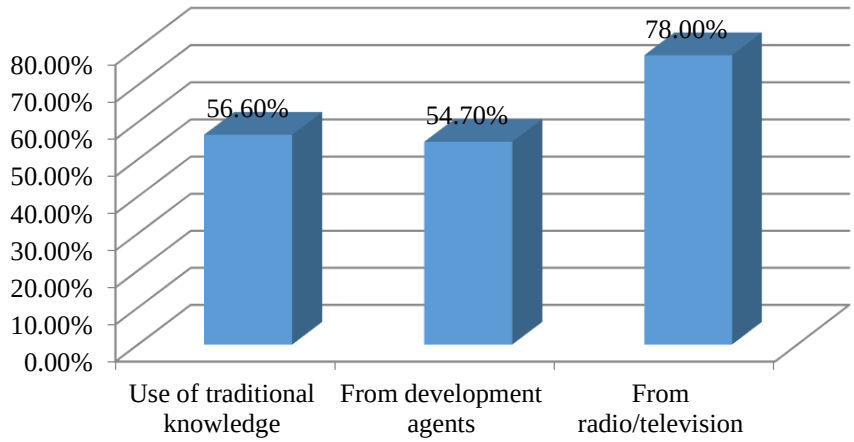

Figure 2.2 Sources of information for weather forecast (Multiple responses)

It should be noted that two important concerns have emerged related to the sources of weather forecast. Figure 2.2 shows use of traditional knowledge, which is a cumulative environmental knowledge build over past experiences (Leonard *et al.*, 2013), is the second most important source of information for weather forecast in the study area. The kind of traditional knowledge huseholds used for weather forecast include direction of wind and color of the cloud. A key informant from the elderly told in a given season if a heavy wind is blowing from the eastern direction more frequently, they judge that the climate will not be favorable for harvest that season. Similarly, in terms of color of cloud, key informants told that heavy dark cloud could indicate there will be good rain that season that help to get good harvest.

Key informants from the elderly, however, raised their concern that value of traditional knowledge is declining especially among the younger generation. During an informal discussion with a resident in *Sara Areda kebele* the informant mentioned education which is equated with 'being civilized' and religion (esp. Orthodox and Protestant) were discrediting the value of traditional sources of knowledge. The informant elaborated these religious faiths discourage their followers in their teachings not to exercise the traditional practices such as "Malkaa bu'uu" and/or "Gaara ba'uu" which were practiced as prayers for good rain or harvest.

The point that needs to be emphasized here is that when one is ignoring the wealth of information obtained from traditional knowledge, he/she automatically forfeits the benefits accrued from using it. To this end, scholars have illustrated that the use of traditional knowledge implies the adoption of a bottom–up participatory approach that encourages the highest level of local participation in climate change programs (Ajani *et al.*, 2013); and the rich cultures and a deep history of an area are important lessons for the development of future adaptation strategies (Leon *et al.*, 2015). Hence, integrating traditional and scientific knowledge, especially in the context of a rapid changing climate, is imperative for the better understanding of and improving adaptation strategies for impacts related to climate change (Gaillard & Mercer, 2012 cited in Leon *et al.*, 2015).

The other big concern is that key informants and discussants in the focus groups have commented that the climate information they get from the DAs was not different from what they know or heard from radio/television. Here, even the DAs admitted this concern and confessed they have no different sources of information than that of the community members. Besides, the

DAs mentioned they did not dare to tell about weather forecast with confidence for fear of failure in their sayings. This is because the households need assurance for what they were advised to do but which could not be guaranteed by the DAs. The problem that the DAs confronted with emanates from the fact that the information they obtain on weather forecasts came from radio/television which are generic in nature. The radio/televisions mostly provide information of the big towns/cities where the weather stations are located. In addition, the forecast is, most of the time, on daily basis which will not give time for preparation. Thus, the DAs could not be confident enough to give assurance for the households.

2.3.4 Barriers to adaptation strategies

Adaptation actions may not take place in a smooth manner. Rather, different factors could affect the processes that make one's effort less effective. In related view, households have identified multiple barriers they faced which have affected their adaptation to climate variability (see Figure 2.3).

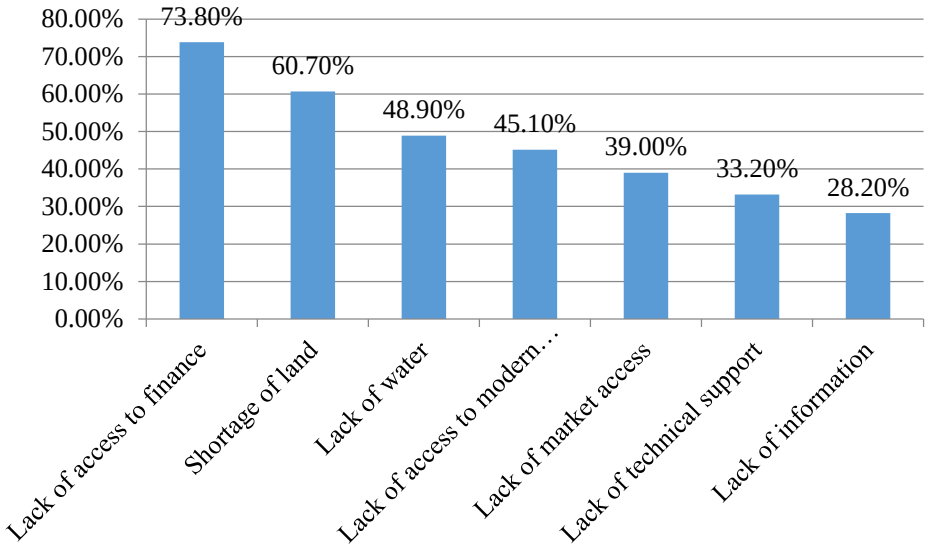

Figure 2.3 Barriers affecting adaptation to climate variability

Figure 2.3 reveals the prime barrier that affected respondents in their adaptation to climate variability is lack of access to finance (73.8%). This survey finding is in conformity with the FDGs and KIIs held in all the six *kebeles*. All the participants attested the lack of access to credit services in their locality. The participants mentioned that even though there are micro-finances it is only members who can get loan. And those members complain that the amount of loan given

was not enough to purchase necessary modern inputs let alone invest into income generating activities.

Fom Figure 2.3 the second constraint that affected households in adapting to climate variability is shortage of land (60.7%). The focus group discussants and key informants mentioned pressure on land is increasing over time in their localities. Discussants informed that especially the younger generations were in a serious problem and just earning their living by sharing their parents' farming lands. Moreover, this increasing population is putting pressure on grazing lands so that community members have reached to a level where they cannot let their cattle to an open grazing field. As a remedy, community members were reducing significantly the number of the cattle they own. This claim is indeed attested by Ali (2008) who stated that livestock asset holding both at household and community levels has been declining in recent years. Similarly, our finding is consistent with Temesgen *et al.* (2009), who argued that high population pressure was forcing farmers to intensively farm a small plot of land and making them unable to prevent further damage by using practices, such as planting trees that compete for agricultural land.

Lack of water (48.9%) was identified as the third constraint affecting adaptation to climate variability (Figure 2.3). As key informants mentioned, the poverty of households and the erratic nature of rainfall in their locality was forcing them not to diversify their livelihood activities. From the *kebeles* where this study was conducted those discussants living in *Buta Wagare*, *Digalu Wanga* and *Tiri Birretti* complained that the shortage of water as the most serious problem, which is inhibiting them not to diversify their livelihood that could have enabled them easily adapt to the impacts of climate variability.

The other important barrier to adaptation identified was lack of access to modern inputs (45.1%). Related to this barrier, focus group discussants and key informants in the sample *kebeles* expressed the existence of a severe shortage of modern inputs, especially improved seeds. According to interviewees and discussants, two problems stand out to be stressed with respect to this barrier.

First, interviewees and discussants mentioned that the already few amounts of the improved seeds that were brought to the district were first provided for the 'model' farmers in their localities and it was in the second or third round that the other farmers get access to these seeds. Furthermore, the discussants and key informants explained that the improved seeds will lose

their productivity by the time they reach the farmers. They elaborated the so called 'model' farmers were getting richer due to this unfair advantage. This is because when the first generation seeds were given to the 'model' farmers their production level will be increased and again when they are reselling, they sell the seeds with higher prices which further their advantage. Such complains of the focus group discussants and key informants were duly acknowledged by the DAs operating in the respective sample *kebeles.* The DAs justify the fact that the amount available to the district was so limited and the receptive nature of the 'model' farmers make them to be prioritized. However, care should be taken since such kind of preferential treatment has a repercussion. To illustrate, Adger and colleagues (2007) quoting scholars (like Ford *et al.* 2006) have highlighted that "some technologies for adaptation being not equally accessible to all, they have potentially contributed to inequalities within the community through differential access to resources".

Second, it was highlighted that not only the time lag until it reaches the farmers but also prices of improved seeds were so high which discourage their use. Among modern inputs, the discussants also mentioned, there was a problem related to fertilizers that not only it delays before reaching the community members, but also most of the time the farmers did not get as per their choice (Urea vs. DAP).

From Figure 2.3 it can be observed that lack of market access (39.0%) was also identified as one of the barriers to adaptation. The issue of market access was raised as a serious concern especially by those focus group discussants who are from *Qawwa Hara Mirqasa* and *Sifa Batte kebeles*. These *kebeles* have irrigation access so that some households were engaged in producing vegetable products like onion, garlic, tomato, papaya, and green pepper. In fact, the complaint in relation to market access was not necessarily about the physical distance of market places, rather the problem was due to the existence of middlemen (brokers).

The discussants in these *kebeles* explained that even though they produce those products outlined, the brokers will come just to the farm and tag prices before it was harvested. Thereafter, these brokers will deter any other individual not to come and purchase those products. Even if the farmers object the offer of those brokers and bring their products to the nearby towns, the brokers will communicate immediately so that no one could buy that product. One of the key informants from *Qawwa Hara Mirqasa* expressed that "you will be tied with your

own products". The discussants added that the chain of the brokers and the traders was so strong that no one can stop them, and they stated "we are just watching while the brokers and traders were getting richer with barely minimum effort".

As to the manipulative role of the brokers, a study conducted in Ghana by Giordano *et al.* (2012) has also found similar situations. Giordano and colleagues have described that where more than 90% of vegetables are sold in local markets (in the remote areas where infrastructure and transport are limited) the middlemen or market women often collude to set prices limiting farmers' ability to negotiate crop prices.

From the discussions made in the preceding paragraphs, it can be derived that the local formal institutions were not providing adequate support that could facilitate better adaptation. Besides, a cross reference of our finding with the literature shows that the problem of barriers to adaptation is not a reality of one particular area. Rather, the comparison of findings among different areas show there were diverse barriers confronted, despite the difference in sequence of their influence across the areas (see e.g. Adger *et al.*, 2007; Temesgen *et al.*, 2009; Moser & Ekstrom, 2010; Sofoluwe *et al.*, 2011; Belaineh *et al.*, 2013).

Another important factor which could have a significant impact on the effectiveness of adaptation and that merit special attention is the timing of the adaptation options. In recognition of this fact, households have identified the time when they are taking adaption actions (Table 2.10).

Table 2.10 Times when respondents take adaptation actions (Multiple responses)

Time of adaptation	Responses		Percent of Cases
	n	Percent	
When faced with problems of climate variability	268	50.4	67.5
With the anticipation of problems of climate variability	90	16.9	22.7
When informed by others (like DAs, or elders)	174	32.7	43.8
Total	532	100.0	134.0

The results from Table 2.10 show 67.5% of the respondents replied to have taken adaptation actions when faced with problems of climate variability. The other 43.8% of the respondents indicated they take adaptation actions when informed by others (like DAs or elders of the community).

To illustrate more on the times of taking adaptation action, in the box below is presented the experience of the head for Disaster Preparedness and Prevention office of Boset district.

Box 1. Reflection of head for Disaster Preparedness and Prevention office of the district. Most of the time we perform our office duties like 'extinguishing the fire', i.e. reacting after a disaster has happened. We know the case should not have been the way it is now, rather everything should be tackled before it becomes a problem. However, there are so many problems faced by our office such as shortage of manpower, lack of logistics (especially vehicle to use it for field purpose), lack of willingness by workers, and the age-old tradition to do things in a reactive way. Finally, we undertake things mainly when pushed by the demand from the community members and the problems encountered.

As can be observed from results of Table 2.10 and Box 1 above, the tradition of taking adaptation actions is reactive. However, such reactive way of response is debilitating. For instance, Maereg *et al.* (2013) have illustrated that even at a country level Ethiopia has been relying on relief aid for far too long mainly because of the tradition of dealing with problems in a reactive manner. Likewise, Adger *et al.* (2007) quoting different authors have commented that a 'wait and see' or reactive approach is often inefficient and could be particularly unsuccessful in addressing irreversible damages. Likewise, Sivakumar *et al.* (2014) have warned that reactive way of responses to droughts is known to be untimely, poorly coordinated, and disintegrated.

2.4 Conclusion and Recommendation

The study shows that the rural households of Boset District have developed awareness about the prevailing climate variability. This appears to be the case due to the frequent occurrence of drought and the related adverse consequences. The results showed that households were not passive to the effects of the climate variability, rather they were found to have pursued a range of adaptation strategies. The decision to take any of the adaptation options available to the farmers was found to be statistically significantly affected by gender, farmland size, access to a weather forecast, total annual income, access to credit service, and distance to input/outputs markets. Furthermore, the findings of this study revealed the existence of multiple barriers to adaptation which include lack of access to finance, shortage of land, lack of water, lack of access to modern inputs, and lack of market access. These arrays of barriers could impose a burden on the households that make adaptation efforts less effective and even could impoverish them further. On top of these, the study has revealed the importance of using multiple sources of data since

some unexpected results such as the unintended beneficiaries of irrigation facilities, the manipulative roles of brokers, and unintended consequences of government interventions were explored by further probing of the survey findings. Therefore, to make the adaptation efforts more effective, the findings suggest that local contexts should be considered, interventions towards the barriers must be multi-faceted, and a proactive approach needs to be pursued.

Chapter 3: Vulnerability to Food Insecurity in the Face of Climate Variability: An Integrated Vulnerability Assessment

Abstract

Rural households in Ethiopia are vulnerable to food insecurity due to the unprecedented climate variability and the incidence of poverty. This study examines the levels of vulnerability to food insecurity in Boset District of East Shewa Zone, Ethiopia. Food insecurity is recurrent in this area and the social vulnerability aspect of the society is ignored. The study was conducted by adopting the mixed methods approach, in which 397 household heads were surveyed, key informants were interviewed, focus group discussions occurred, and personal observations were recorded. The levels of vulnerability were measured through the integrated vulnerability assessment approach and weights were applied for each of the indicator variables via a Principal Component Analysis (PCA). Accordingly, more than half (52.6%) of the total respondents were found to be highly vulnerable, i.e., with negative potential impact, followed by 28.5% being vulnerable, and 18.9% were considered less vulnerable. The findings also showed a statistically significant difference (at $p<1\%$) that there were differences in levels of vulnerability to food insecurity across the sample *kebeles*. Hence, to lessen the resulting potential impact of exposure and sensitivity, interventions shall focus on enhancing the adaptive capacities of households, and need to prioritize those *kebeles* with high vulnerability. Furthermore, results of the study suggest that future research should take into account the time dimension of vulnerability to food insecurity.

Keywords: Adaptive capacity; Climate variability; Exposure; Food insecurity; Integrated vulnerability assessment; Sensitivity

3.1 Introduction

Reducing food insecurity continues to be a major public policy challenge in developing countries (Babatunde & Qaim, 2010). A similar situation prevails for Ethiopians who live in the rural areas (CSA & WFP, 2014; Diriba *et al.*, 2017; Malla *et al.*, 2017; Zewdie *et al.*, 2017). It was found that in Ethiopia 7–8 million people are routinely protected every year through the *mainly donor-funded* Productive Safety Nets Program [PSNP] (Devereux *et al.*, 2008). The country constitutes one of the seven African countries that account half of the food insecure population in Sub-Saharan Africa (Mesfin W., 2014); and it receives between 20% - 30% of all food aid to sub-Saharan Africa (Sosina & Holden, 2008).

There are many food insecurity studies that have been conducted in Ethiopia. A closer analysis of these studies shows that they were focused on understanding the current situation (see e.g., Diriba *et al.*, 2017; Malla *et al.*, 2017; Zewdie *et al.*, 2017) and may not necessarily be investigating future prospects. In addition, studies have also confirmed that food insecurity is spatially varied (Zewdie *et al.*, 2017). Thus, other studies justify the need for further research that covers different areas and also incorporates the investigation of future prospects.

Given the fact that food insecurity is precarious in Ethiopia (van der Veen & Tagel, 2011; Adugna & Wagayehu, 2012; Mesfin W., 2014), to solve this problem and assess food insecurity with respect to vulnerability is of utmost importance. This is because reducing vulnerability is a prerequisite for addressing food security targets (Lovendal & Knowles, 2006); there is a growing recognition that the causes of food crises and other disasters are not so much natural as social, political, and economic (Burg, 2008). To substantiate, it is possible to see an argument forwarded by Kelman *et al.* (2016) that development decisions creating and perpetuating vulnerability are the root causes of disasters, not environmental phenomena which sometimes become hazardous. The authors added that, from this vulnerability viewpoint, disasters are not 'natural', neither in the sense of being from nature nor in the sense of being normal and acceptable. Lastly, identification of the characteristics of households likely to be vulnerable to food insecurity can allow for targeted food security strategies (Ndobo & Sekhampu, 2013).

Furthermore, understanding the food insecurity by focusing on the situational vulnerability of households has added advantages, which include addressing the issue of future incidents of food insecurity (Scaramozzino, 2006); to be more forward-looking and dynamic by incorporating the

elements of risk and coping capacity into the assessment (Riely, 2000), and understanding the trend that many households frequently move in and out of a state of under-nutrition (Capaldo *et al.*, 2010) suggesting that the notion of food insecurity is best thought of in a dynamic sense. Finally, it has also been demonstrated that vulnerability refers a potential event (e.g., of being harmed) and not to the realization of this event and so it concerns a judgment that refers to a possible future (Ionescu *et al.*, 2009).

Despite the fact that vulnerability assessment is advantageous in the ways discussed in the preceding paragraphs, it was observed from the literature review that the vulnerability aspect of food insecurity in Ethiopia has been given no or minimal attention (Lautze & Maxwell, 2007; Workneh *et al.*, 2011; Lemma & Wondimagegn, 2014; and, Sandstrom & Juhola, 2017). For instance, a review of documents that dealt with the food crises, which occurred in Ethiopia in 1999–2000 and 2002–2003, revealed the lack of a coherent, post-crisis strategy to reduce the embedded vulnerabilities that characterize a wide range of Ethiopian livelihoods systems (Lautze & Maxwell, 2007). These same authors have also observed that, even in the Poverty Reduction Strategy Paper (PRSP) of Ethiopia, there was a failure to acknowledge the fact that Ethiopia's disasters were occurring due to the country's ecological, economic, political, and social systems (Lautze & Maxwell, 2007). These authors commented on the historical view that, disasters strike at the whim of nature remains powerful in contemporary Ethiopian development discourse.

Similarly, Sandstrom and Juhola (2017) have recently assessed various documents in Ethiopia and concluded that the 'drought narrative' is predominant, while the 'vulnerability narrative' is much less visible, especially in the appeal documents that are used to raise funding for relief. To the contrary of the position held by the Ethiopian authorities, however, many scholars contend that "an inability to tackle chronic food insecurity indicates a number of institutional, economic and political problems" (Ericksen *et al.*, 2010). Futhermore, authors have argued this could be partly because "the economic and political factors that contribute to vulnerability and risk are intractable and these issues can shake the politically ruling power" (Armas & Gavris, 2016, p. 139). Therefore, these authors pointed out that the ruling bodies tended to focus on the physical or engineering aspects of a hazard, thus avoiding 'explosive' problems such as social vulnerability (Armas & Gavris, 2016).

Naturally, disasters like drought may worsen food insecurity and malnutrition (Tesfamicheal *et al.*, 2016). Especially if these disasters are more frequent they affect not only food security levels, but could also lead people to make use of a destructive and depletive response by selling assets at prices below their real value, leading to potential poverty traps (Dercon & Christiaensen, 2011). However, it has been suggested that "lessening the effects of disasters would involve reducing vulnerability through socio-economic interventions, rather than solely attempting to diminish the impact of hazards through technological or engineering feats" (Burg, 2008, p. 610).

Therefore, from the literature review it can be understood that apart from the rationale discussed so far, assessing the vulnerability of households to food insecurity is required because of the relatively few empirical studies found in the literature in general (Babatunde *et al.*, 2008), and particularly within Ethiopia (Workneh *et al.*, 2011; Lemma & Wondimagegn, 2014). There is a need for more research to identify the highly vulnerable micro-environments and associated households in order to provide agronomic and economic coping strategies for the affected populations (IPCC, 2007). In addition, place-based studies are both necessary and essential for understanding the dynamics of vulnerability (Ford & Furgal, 2009). This study differs from previously conducted research works in that the vulnerability levels of households to food insecurity have been mainly measured using concepts borrowed from poverty gap studies (such as Value at Risk and the Foster-Greer-Thorbecke [FGT] models) but we have adopted the integrated vulnerability assessment approach to add variety to the extant literature.

The main objective of this study is to examine the levels of vulnerability to food insecurity in Boset district of East Shewa zone by employing the integrated vulnerability assessment approach. To this effect, data were collected through multiple methods so as to triangulate the findings and gain a comprehensive understanding of the situation. By doing so, this paper contributes to the growing literature on food insecurity, helps to reorient the thinking and action of decision makers, aids in prioritizing the meager resources at hand, and reinforces the importance of incorporating the aspect of vulnerability whenever food insecurity is assessed.

3.2 Theoretical Framework

3.2.1 Conceptualization of vulnerability

The concept of vulnerability, the susceptibility to food insecurity or not being able to meet food needs, has become an important part of food security analyses since the 1980s (Burg, 2008). However, vulnerability is not a straightforward concept, and there is no consensus as to its precise meaning, the term is used to mean different things to different authors (Adger *et al.*, 2004; Fussel & Klein, 2006; Fussel, 2007; Babatunde *et al.*, 2008; Burg, 2008; Thabane, 2015).

The Food and Agricultural Organization of the United Nations (FAO) defines vulnerability as "the presence of factors that place people at risk of becoming food insecure or malnourished" (FAO, 1999, p. 11). Similarly, Andrews and Flores (2008) defined vulnerability as "the full range of factors that place people at risk of becoming food insecure, including those factors that affect their ability to cope" (p. 2). In addition, vulnerability is defined as "a relative measure, for a given population or region, of the underlying factors that influence exposure to famine and predisposition to the consequences of famine" (Downing, 1990, p. 9). Thus, vulnerability can be considered as comprised of risks (or a chain of risky events) that people confront in pursuit of their livelihoods, the sensitivity of the livelihood to these risks, the risk response or the options that people have for managing these risks and finally the outcomes that describe the loss in well-being (Turner *et al.*, 2003).

Given the definitions provided above and the recommendations of scholars, vulnerability in this study is treated as a concept determined by the exposure, physical setting and sensitivity, and by the ability and opportunity of households to adapt to change (Adger, 2006).

3.2.2 Approaches to vulnerability assessment

No *single* indicator or *single* theory of vulnerability will be helpful or credible for the purpose of understanding and lessening the vulnerability of a specific place or system (Patt *et al.*, 2009). Given that vulnerability is a relative measure (Fussel & Klein, 2006; Patt *et al.*, 2009), its assessment is affected by the disciplinary biases of individuals involved (Adger *et al.*, 2004). Therefore, empirical studies suggest the assessment can be categorized into three basic approaches: the natural hazards and disaster approach (biophysical), the social vulnerability approach, and the integrated approach (Yamin *et al.*, 2005; Fussel, 2007).

Scholars observe that the biophysical approach focuses on hazards, the dose-exposure of affected communities to identified impacts, and hazard-related vulnerabilities (Yamin *et al.*, 2005; Brooks, 2003). The implication is that factors such as the frequency, intensity and nature of the physical hazard and the exposure of communities to such hazards are key components of vulnerability (Yamin *et al.*, 2005). On the other hand, the social vulnerability approach of assessing vulnerability is referred to as ‘‘the state of individuals, groups or communities in terms of their ability to cope with and adapt to any external stress placed on their livelihoods and well-being” (Fussel, 2007). In this case vulnerability is determined by the availability of resources and, crucially, by the entitlement of individuals and groups to call on these resources (Fussel, 2007). Thus, vulnerability is something that exists within systems independently of external hazards (Brooks, 2003). For many human systems, Brooks (2003) citing different authors, views vulnerability as an inherent property of a system and that it arises from the internal characteristics of that system, and thus it may be termed “social vulnerability”.

The third approach, i.e., the integrated approach, combines the ‘internal’ factors of a vulnerable system with its exposure to ‘external’ hazards (Fussel, 2007). Again, this approach is known to be determined by conditions such as the physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impacts of hazards (Yamin *et al.*, 2005).

Among the three approaches discussed so far, the integrated vulnerability assessment approach is adopted to inform this particular study. This is because the approach links the two views that vulnerability depends on both biophysical and human factors (Ribot, 2010), offsets the limitations raised against each of the previous two approaches, and because most of the scientific community nowadays tends to prefer it. Accordingly, based on the discussions made so far, the analytical framework employed in this study is presented in Figure 3.1.

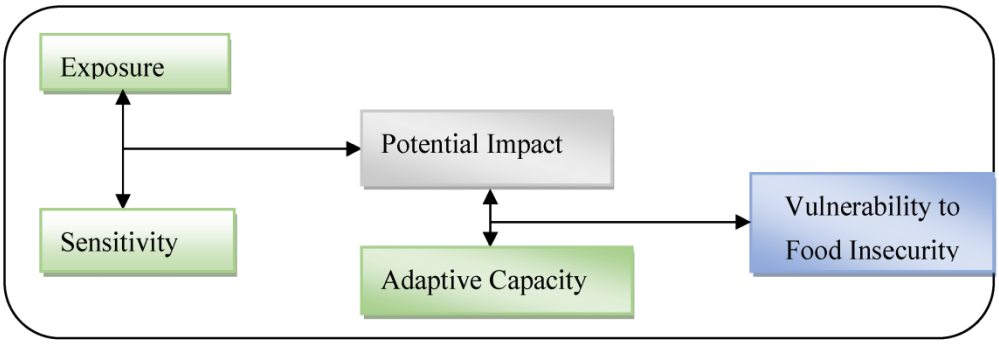

Figure 3.1 A framework of vulnerability to food insecurity as a function of exposure, sensitivity, and adaptive capacity.

Source: Adapted from Ionescu *et al.* (2009); and Geronimo *et al.* (2013)

It can be observed from the framework that vulnerability is a hierarchical aggregation of the three components: exposure, sensitivity and adaptive capacity (Smit & Wandel, 2006). In this analytical framework the analysis of the vulnerability to food insecurity begins with examination of the exposure and sensitivity components, which are inseparable properties of a system. Thus, exposure and sensitivity linked together affect potential impact (Gbetibouo *et al.*, 2010). The framework shows the exposure is related to climate variability since the units of analysis are rural households who earn their living mainly from agriculture. It has been argued that the role played by climate variability and change in affecting the dimensions of food (in)security is so crucial that the impact of climate variability on increased vulnerability to food insecurity is quite significant (Karfakis *et al.*, 2011).

Sensitivity and exposure together could contribute to food insecurity which arise primarily out of climatic variability and extreme precipitation events that occur more frequently as a result of climate change (Westerhoff & Smit, 2009). As the livelihood of the rural people is heavily dependent on agriculture which is sensitive to occurrence of extreme climate events, some potential impacts (like water scarcity, crop failure, conflict over resources) may result. However, these potential impacts will not result directly into food insecurity, but rather adaptive capacities of the households will come into play to moderate the adverse effects. Hence, based on the access to resources to assist the households in coping with the potential impacts, the level of vulnerability could be determined. Here we used the term vulnerability to food insecurity because it was mentioned by scholars like Burg (2008) that people and places are not simply vulnerable: they are vulnerable *to* something, in this case food insecurity.

3.3 Materials and Methods

3.3.1 Description of the study area

Boset district extends between $8^0$24'- $8^0$51' North latitude and $39^0$16'- $39^0$50' East longitude. It is located in the northeast part of East Shewa zone, Oromia National Regional State. It is bordered with Adama district in the west; by Amhara Regional State in the north; Fantale district in northeast and by Arsi zone in southeast. Based on the results of National Population and Housing Census of Ethiopia, conducted in May 2007, a population projection was made for all Regions and Districts from 2014 – 2017. Accordingly, data obtained from Central Statistical Agency [CSA] (2013) indicated that the total population of Boset district for the year 2017 was projected to be 189,795 out of which 42,793 (22.5%) are urban population and 147,002 (77.5%) are rural population.

A report obtained from Boset district's Finance and Economic Development Office (2012) revealed the district is located in the midst of the Great Rift Valley, which extends from the North to South of the district. Climatically most parts of the district (about 89%) belong to tropical (*kolla*) agro-climatic zone and the remaining small section (about 11%) is sub-tropical (*woina dega*). The district is also characterized by hot and dry weather with an average annual temperature which varies between 25 – 30^0C for the tropical (*kolla*) and 15 – 20^0C for the sub-tropical (*woina dega*). The rainfall is weakly bi-modal with spring (a small rainy season) during the months of April and May while summer (a long rainy season) during the months of July - September. The average annual rainfall ranges between 700 – 800 mm with the intensity and variability being high in the district. In terms of drainage system, the district falls in the Awash River Basin, with no other major streams and lakes.

3.3.2 Research design and sampling

This study was conducted in Boset District, East Shewa zone of Oromia National Regional State. It was undertaken as a cross-sectional survey using mixed methods research approach. The choice of mixed methods was dictated by the research problem under investigation and to benefit from the merits of using this research approach (Johnson & Onwuegbuzie, 2004; Creswell, 2009, 2012; Creswell & Clark, 2011).

In terms of data sources, both primary and secondary sources were utilized. The primary data were generated by employing household survey that was administered by 12 Development Agents (DAs) who were familiar to the study area and conversant with the local language (Afan Oromo). After pretesting and fully developing the structured questionnaire, it was administered face-to-face. Key informant interviews were also held with heads of offices and focal persons from health, women's and children's affairs, water resources, irrigation, crop production, livestock production, natural resources management, disaster preparedness and prevention, World Vision Ethiopia (Boset Area Development Program), and community elders living in the sample *kebeles*.

Similarly, focus group discussions consisting of six men's and four women's groups were conducted separately with members, each comprising 6–10 individuals. The groups were formed on a volunteer basis with the help of the DAs working in the respective sample *kebeles*. The criteria for inclusion in the group discussion were household heads who have lived in the *kebele* for more than five years and who had some knowledge of food insecurity issues. Lastly, personal observations coupled with informal discussions were also employed to generate primary qualitative data. In addition, we have utilized current and relevant journal articles mainly published within the last ten years as sources of secondary information.

To have a full picture of the district, a total of 6 *kebeles* located at different places were selected by district level experts. Food insecurity status, access to irrigation facilities, and participation in the Productive Safety Net Program (PSNP) were used as criteria for selecting the sample *kebeles*. The PSNP was used as one criterion to get those *kebeles* which are chronically food insecure, this is because it is only 10 *kebeles* of the district under the PSNP. Otherwise, it was not the intension of this study to assess the impacts of PSNP.

A list of households living in each of the selected *kebeles* was taken as a sampling frame, then respondents were selected using a systematic random sampling technique proportionate to the size of households living in each *kebele*. The systematic random sampling technique was employed because it is a probability sampling method and is easy to manipulate during the selection of the sample households (Babbie, 2008; Bryman, 2012). Using the formula developed by Yamane (1967) as cited in Israel (2013), the sample size was calculated and resulted in a total of 397 participants (48 female- and 349 male-headed households). In the determination of the

sample size, a 95% confidence level and a *p*-value of 0.05 for maximum variability were assumed.

Mathematically, the formula is presented as:

$$n = \frac{N}{1 + N(e)^2}$$

Where *n* stands for the sample size, *N* signifies the total number of households in all the *kebeles*, and *e* designates maximum variability which is 5% (0.05).

3.3.3 Methods of data analysis

The examination of vulnerability to food insecurity undertaken in this study was conducted through the integrated vulnerability assessment approach by taking into account the three components of vulnerability: the exposure, sensitivity, and adaptive capacity of the households concerned.

Vulnerability is not a directly observable phenomenon (Ellis, 2003; Luers *et al.*, 2003), thus we adopt the most common method of quantifying vulnerability by using a composite of proxy indicators. The reason for using indicators is that they seem to be useful media because they synthesize complex state-of-affairs, such as the vulnerability of households, into a single number that can then be easily used (Hinkel, 2011). Thus, the respective indicators chosen were made to represent the biophysical and socio-economic conditions of the rural households.

However, it must be noted that this approach has certain limitations in that indices are limited in their application by considerable subjectivity in the selection of variables and their relative weights, by the availability of data at various scales, and by the difficulty of testing or validating the different metrics (Luers *et al.*, 2003).

The model specification is given as:

$$\text{Vulnerability} = (\text{Adaptive Capacity}) - (\text{Sensitivity} + \text{Exposure}) \quad (3.1)$$

As can be seen from Eq. 3.1 a negative value is attached to both exposure and sensitivity and a positive value for adaptive capacity following the works of Temesgen *et al.* (2008), Workneh *et al.* (2011), Gutu *et al.* (2012), and Opiyo *et al.* (2014). When the adaptive capacity of the household exceeds that of its sensitivity and exposure, the household becomes less vulnerable to

the impacts and the reverse is also true (Opiyo *et al.*, 2014). In other words, areas which are highly exposed to climate shocks are more sensitive to damage, assuming constant adaptive capacity (Gutu *et al.*, 2012; Opiyo *et al.*, 2014). Therefore, a higher net positive value implies lesser vulnerability to food insecurity and vice versa.

The vulnerability indicators measured, however, need first to be normalized as the ratio of the difference between the actual value and pre-selected minimum, and the range of maximum and minimum values of indicators (Hahn *et al.*, 2009) so as to overcome problems of scale of measurement (Workneh *et al.*, 2011; Menberu, 2016). The normalization process is done to the range of values in the dataset by applying the following general formula:

$$Index\ value = \frac{(Actual\ values - Minimum\ values)}{(Maximum\ values - Minimum\ values)} \qquad (3.2)$$

Next to normalization of the selected indicators comes attaching weight for them. To this end, after reviewing different literatures Gbetibouo *et al.* (2010) summarized that there are three methods which are used to assign weights to indicators: (1) expert judgment; (2) arbitrary choice of equal weight; and (3) statistical methods such as principal component analysis or factor analysis. Due to the inherent shortcomings of the first two methods, such as indicators not equally affect vulnerability, possibility of expert's judgment to be subjective, and even due to lack of the appropriate experts in the area (Gbetibouo *et al.*, 2010), in this study the use of principal component analysis (PCA) is opted to generate weights for the indicators.

Principal Component Analysis is frequently used in research that constructs indices for which there are no well-defined weights (Temesgen *et al.*, 2008; Gutu *et al.*, 2012); the PCA generated the weights, based on the assumption that there is a common factor that explains the variance in the vulnerability (Gutu *et al.*, 2012). The generation of weights through PCA was performed using standard statistical software, i.e. STATA (Version 12.0).

When it comes to the construction of the vulnerability index, the following model specification is used:

$$V_i = \left(A_1X_{1j} + A_2X_{2j} + \ldots + A_nX_{nj}\right) - \left(A_{n+1}Y_{1j} + A_{n+2}Y_{2j} + \ldots + A_{n+n}Y_{nj}\right) \qquad (3.3)$$

where V_i is vulnerability index, while *Xs*, are elements of adaptive capacity, and *Ys* are exposure and sensitivity. The values of X and Y are obtained by normalization using their mean and

standard deviation. For instance, $X_{1j} = (x_{1j} - x_1^*)/s_1^*$, *where* x_1^* is the mean of x_{1j} across the different households, s_1^* is its standard deviation.

A_1 is the principal component result of factors. In this regard, the first principal component of a set of variables is the linear index of all the variables that captures the largest amount of information common to all the variables (Vyas & Kumaranayake, 2006; Temesgen *et al.*, 2008; Workneh *et al.*, 2011; Gutu *et al.*, 2012; Opiyo *et al.*, 2014).

It follows that the whole matrix of X_{1j} appears as:

$$X_{ij}/Y_{ij} = \begin{cases} (X_{11} + X_{12} + \cdots + X_{1n}) - (Y_{11} + Y_{12} + \cdots + Y_{1n}) \\ \vdots \\ (X_{m1} + X_{m2} + \cdots + X_{mn}) - (Y_{m1} + Y_{m2} + \cdots + Y_{mn}) \end{cases} \quad (3.4)$$

The *i* and *j* in the foregoing notation imply the number of rows (in this case is the 397 individual households) and the number of columns (17 variables of adaptive capacity, exposure and sensitivity).

In **Eq. 3.3**, the *As*, are the first component score of each variable computed using PCA. Finally, the vulnerability index of each household is obtained using **Eq. 3.5** as follows:

$$V_i = \begin{pmatrix} A_1 \\ A_2 \\ \vdots \\ A_{n+n} \end{pmatrix} \times \begin{cases} (X_{11} + X_{12} + \cdots + X_{1n}) - (Y_{11} + Y_{12} + \cdots + Y_{1n}) \\ \vdots \\ (X_{m1} + X_{m2} + \cdots + X_{mn}) - (Y_{m1} + Y_{m2} + \cdots + Y_{mn}) \end{cases} \quad (3.5)$$

Finally, based on the results obtained from **Eq. 3.5** the households are classified into three categories, i.e. highly vulnerable, vulnerable and less vulnerable. However, it should be noted that the value of the index computed is not an absolute value (Opiyo *et al.*, 2014).

Determinants of vulnerability to food insecurity

The proposed determinants of vulnerability to food insecurity are identified from various empirical findings cited frequently in the literature, being informed with relevant theories, and based on availability of data.

The exposure is determined by the frequency and the severity of natural and man-made hazards (WFP, 2009). Accordingly, perception on increased temperature and rainfall adequacy, and perception on frequency of drought and flood occurrence were the indicators used to be measured. The assumption here is that increased temperature and inadequate rainfall, and

farming households exposed to higher frequency of droughts or floods are more vulnerable (see also Temesgen *et al.*, 2008; Gbetibouo *et al.*, 2010; Workneh *et al.*, 2011; Gutu *et al.*, 2012; Opiyo *et al.*, 2014).

Sensitivity, on the other hand, is considered to reflect the responsiveness of the household to climatic influences and is shaped by both socio-economic and environmental conditions (SEI 2004 cited in Gbetibouo *et al.*, 2010). It was assumed, those areas with higher frequencies of climate extremes (e.g., drought and flood) were subjected to higher sensitivity due to loss in yield and thus loss of livelihood, given that the main source of livelihood in rural Ethiopia is agriculture (Temesgen *et al.*, 2008). Thus, decline in farmland holding and crop production, food shortage, water scarcity, and incidence of conflict were the identified indicators (see also Swift, 2006; Workneh *et al.*, 2011; Opiyo *et al.*, 2014; Dabalen & Paul, 2014; Awal *et al.*, 2016).

The adaptive capacity component of the vulnerability is taken as "the potential or ability of a system, region, or community to adapt to the effects or impacts of climate change" (IPCC, 2007). This component mainly constitutes the asset portfolio of the households concerned (Gbetibouo *et al.*, 2010). It was argued that "the more assets people have, the less vulnerable they are; conversely, the greater the erosion of people's assets, the greater their insecurity" (Moser, 1998). Accordingly, the following are indicators of adaptive capacity for this study, namely: gender, literacy level, access to non-farm income, total farmland size, access to communal resources, access to irrigated land, gross household annual income, availability of assistance by *kebele*, equality of women on resource ownership, access to agricultual extension service, access to health extension support, access to credit service, and availability of formal supporting organizations (see also Temesgen *et al.*, 2008; Workneh *et al.*, 2011; Notenbaert *et al.*, 2013; Gutu *et al.*, 2012; Opiyo *et al.*, 2014; Tesfahun *et al.*, 2015).

Table 3.1 Components of vulnerability, units of measurement, and hypothesized functional relationship with vulnerability

Components of vulnerability	*Units of measurement*	*Hypothesized functional relationship with vulnerability*
Adaptive capacity		
Male headed households	%	The higher the percentage of the rural households with asset ownership, and have access to the different services available, the lesser the vulnerability.
Households with formal education	%	
Access to non-farm income	%	
Total farmland size	Hec.	
Access to communal resources	%	
Access to irrigated land	%	
Gross household annual income	Birr*	
Access to weather forecast	%	
Availability of farm equipment	%	
Availability of assistance by *kebele*	%	
Equality of women on resource ownership	%	
Access to agri. extension service	%	
Access to health extension support	%	
Access to credit service	%	
Availability of formal supporting organizations	%	
Sensitivity		
Decline in crop production	%	The higher the percentage of households affected by extreme weather events and incidence of conflict, the higher their vulnerability.
Food shortage	%	
Water scarcity	%	
Unsafe waste disposal	%	
Incidence of conflict	%	
Exposure		
Perception on temperature increase	%	Increasing incidence of drought and frequency coupled with increased temperature and inadequate rainfall, increase the vulnerability.
Perceived frequent drought	%	
Perceived frequent flood	%	
Perception on inadequacy of rain	%	

**Birr* is the currency for Ethiopia

3.4 Results

3.4.1 The characteristics of households in the study area

The household heads included in the study were comprised of 349 (87.9%) male- and 48 (12.1%) female-headed households. The household size ranged between 2 and 14 members, with an average of six people per household, and as to the dynamics, 50.6% of the respondents claimed to have observed an increase in the size of household members while the remaining 39% and 10.4% observed either a decrease or no change, respectively. The age of household heads ranged from 21 to 86 years, with an average of 44 years. Out of the total respondents selected, 90 (22.7%) were illiterate, 78 (19.6%) could only read and write, 164 (41.3%) attended elementary school (1–6 grades), 52 (13.1%) attended junior (7–8 grades) school, and 13 (3.3%) of them reached high school levels. In fact, there was disparity between male-headed and female-headed

households, with the former having received a more formal education with a statistical significance level of 10%.

Only 15.1% of the total respondents were engaged in non-farm activities to gain additional income. The non-farm activities constituted selling local drinks, petty trading, making handicrafts, and selling forest products (charcoal and firewood). Ownership of farmland size ranged from 0.25 to 6 hectares, with an average of 1.6 hectares, and about 60.7% of the total respondents owned less than or equal to 1.5 hectares. Similarly, with respect to the trend of land holding, 45.6%, 31.2%, and 23.2% of the respondents experienced decreased, not changed, and increased land holdings, respectively. The gender dimension of owning farmland depicts the existence of a statistically significant difference (at less than 1% significance level): male-headed households own more farmland than their female counterparts. As is indicated owning greater farmland could help in reducing the level of vulnerability which implies the male household heads would be in a better position in this regard.

As far as level of crop production over the last 5-10 years is concerned, about 61.7% (n=245) have confronted with decline in their crop production. The others which constitute 22.4% (n=89) and 15.9% (n=63) reported not changed and increased, respectively, in their production level over the stated period. For those who mentioned decline in crop production, some of their reasons include lack of access to modern inputs, recurrence of drought, land degradation, and inability to purchase modern inputs. It was only 40% (n=159) of the respondents that reported to have access to communal resources. In addition, only 33.5% (n=133) of the respondents have access to irrigable land, in which the male household heads having better access than their female counterparts, at $p<0.05$ statistical significance level.

3.4.2 Results from the Principal Component Analysis

The PCA was run on the indicators identified in Table 3.1, and the result revealed nine components with eigenvalues greater than one for the data set on vulnerability indicators. These nine components explained 58.6% of the total variation in the data set.

As per the argument made in the methods of data analysis section for the use of PCA in constructing indices, the first principal component is considered for the computation, which explained the majority of the variation in the data set. The results of the factor scores on the first

PCA (see Table 3.2) show positive association with 11 out of the 15 indicators of the adaptive capacity; and negative association with 6 of the 9 indicators of sensitivity and exposure.

The vulnerability indices were therefore constructed for the indicators of adaptive capacity that had a positive association with the first PCA, and for those indicators of sensitivity and exposure that had a negative association. This is because adaptive capacity is considered to be positively contributing to the reduction of vulnerability, while exposure and sensitivity negatively contribute to vulnerability reduction (Opiyo *et al.*, 2014). Thereby, those indicators selected were the ones which were in line with our hypothesized relationship vis-à-vis vulnerability (see Equation (3.1)). Thus, out of the 24 indicators we initially considered, only 17 of them were employed in constructing the vulnerability index.

Using the factor scores obtained from the PCA and the standard score of each indicator, the vulnerability index of each household was computed, which resulted in 397 indices for the sample population with a minimum value of −2.96209 and a maximum value of 3.84875. As there are no universally accepted cut-off points, following the works of scholars (Workneh *et al.*, 2011; Karfakis *et al.*, 2011) households were classified into three categories, in which those households with a vulnerability index of less than 0 were highly vulnerable, those with an index value between 0 and 1 were vulnerable, and those with an index value above 1 were less vulnerable. Here it should be noted that vulnerability is thought as a continuum (Lovendal & Knowles, 2006; Babatunde *et al.*, 2008). Accordingly, it was found that 52.6% (*n*=209) of the total respondents were highly vulnerable to food insecurity. The remaining 28.5% (*n*=113) and 18.9% (*n*=75) were vulnerable and less vulnerable, respectively.

Table 3.2 Normalized values and factor scores of the first principal component

Indicators	Unit	Actual	Normalized score	Factor score
Adaptive Capacity				
Male headed households	%	87.9	0.12	-0.1656
Households with formal education	%	57.7	0.42	-0.1071
Access to non-farm income	%	15.1	0.85	**0.2208**
Total farmland size	Hec.	1.6	0.76	**0.2712**
Access to communal resources	%	40.0	0.60	-0.1660
Access to irrigated land	%	33.5	0.66	-0.2464
Gross household annual income	Birr	13527.36	0.76	**0.0844**
Access to weather forecast	%	91.7	0.08	**0.1641**
Availability of farm equipment	%	37.5	0.63	**0.2000**

Availability of assistance by *kebele*	%	22.4	0.78	**0.0911**
Equality of women on resource ownership	%	71.5	0.28	**0.1819**
Access to agri. extension services	%	80.4	0.20	**0.1238**
Access to health extension support	%	73.3	0.27	**0.2878**
Access to credit service	%	28.2	0.72	**0.1417**
Availability of formal supporting organizations	%	57.2	0.43	**0.2798**
Sensitivity				
Decline in crop production	%	61.7	0.62	0.0744
Food shortage	%	91.7	0.92	**-0.2353**
Water scarcity	%	56.9	0.57	**-0.2350**
Unsafe waste disposal	%	36.0	0.36	0.3983
Incidence of conflict	%	19.9	0.20	**-0.1629**
Exposure				
Perception on temperature increase	%	79.6	0.80	**-0.0086**
Perceived frequent drought	%	88.9	0.89	**-0.2999**
Perceived frequent flood	%	24.7	0.25	0.0260
Perception on inadequacy of rain	%	94.2	0.94	**-0.2157**

Based on the computation made to construct the vulnerability index of households, levels of vulnerability were also examined across the sample *kebeles*. Results are presented below in Table 3.3.

Table 3.3 Levels of vulnerability to food insecurity across *kebeles*

Name of *kebele*	Levels of vulnerability						Total	
	Highly vulnerable		Vulnerable		Less vulnerable			
	n	%	*n*	%	*n*	%	*n*	%
Buta Wagare	3	14.3	3	14.3	15	71.4	21	100.0
Digalu Wanga	8	26.7	7	23.3	15	50.0	30	100.0
Q/H/Mirqasa	138	86.2	19	11.9	3	1.9	160	100.0
Sara Areda	15	28.8	22	42.4	15	28.8	52	100.0
Sifa Batte	35	32.4	50	46.3	23	21.3	108	100.0
Tiri Birreti	10	38.5	12	46.1	4	15.4	26	100.0
Total	209	52.6	113	28.5	75	18.9	397	100.0

Pearson chi2(10) = 168.4835 Pr = 0.000

Results from Table 3.3 show that there was statistically significant level of difference (at $p<1\%$) in vulnerability to food insecurity across the sample *kebeles.* Accordingly, the finding reveals about 86.2% of the households in *Q/H/Mirqasa kebele* were highly vulnerable to food insecurity,

followed by *Tiri Biretti* and *Sifa Batte* with 38.5% and 32.5% of the respondents falling in the same category, respectively. Such a large percentage of households were highly vulnerable in *Q/H/Mirqasa kebele* partly because the soil is mainly stoney which makes it less favorable for crop production and due to its distance from the center (Wolanchity) basic infrustructures are critically lacking there. In contrast, respondents from *Buta Wagare* (71.4%) and *Digalu Wanga* (50%) were found to be less vulnerable to food insecurity.

The finding from Table 3.3 is somewhat in line with what was initially indicated by the district level experts when selecting the sample *kebeles*. By that time, the experts had identified *Buta Wagare*, *Digalu Wanga* and *Tiri Biretti kebeles* to be better in their status of food security. In contrast, *Q/H/Mirqasa*, *Sifa Batte*, and *Sara Areda* were selected to represent those *kebeles* which were highly food insecure. As to the implication of the findings, the local authorities and other stakeholders working on food insecurity should undertake interventions based on the levels of vulnerability, so as to be effective in their endeavor.

To have a better grasp of the levels of vulnerability to food insecurity, the study finding is also presented according to gender in Figure 3.2.

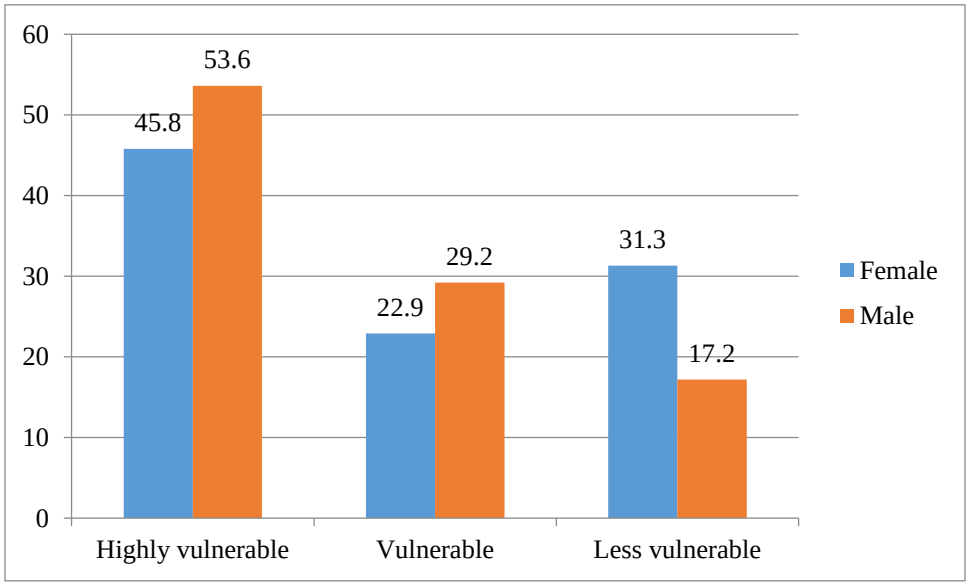

Figure 3.2 Levels of vulnerability to food insecurity according to gender

The findings of Figure 3.2 reveal that female-headed households were better in their levels of vulnerability to food insecurity, in all the three categories of vulnerability, when compared to their male counterparts. This finding is statistically significant at the 10% significance level. This

relative better position could be because female-headed households had better access to credit (statistically significant at <5%) and they were more engaged in non-farm activities (again statistically significant at <5%).

3.5 Discussion

The levels of vulnerability to food insecurity measured show more than half of the total respondents were highly vulnerable, which could be attributed to different reasons. To begin with, the findings show that only 15.1% of the respondents diversified their source of income into non-farm activities. In fact, when households diversify their income sources it can serve as a buffer so that the risk of becoming food insecure is minimized. It was shown that a heavy reliance on limited income sources had severe consequences when some shock (like drought) was encountered. For example, an agricultural dependence suggests that the income effects of a decline in agricultural productivity (all else equal) could be significant (Burke & Lobell, 2010), which may end up raising the level of vulnerability.

Total farmland size was the other variable found to have a positive contribution towards minimizing the level of vulnerability in the study area. This is because more farmland may allow crop diversification, which serves as an insurance against the adverse effects of unusual climate variability. Similarly, Abebaw and Ayalneh (2007) have found that among rural households in Dire Dawa the incidence of food insecurity was inversely related to the farm size of the household. On top of this, asset holdings (which can be expressed in terms of availability of farm equipment in our case) have considerable effects on reducing the vulnerability levels of farming households. Of course, a study conducted in Nicaragua (Karfakis *et al.*, 2011) and another study in Ethiopia (e.g. Tesfahun *et al.*, 2015) obtained similar findings, which confirmed the positive contribution of asset holdings in reducing vulnerability.

An increase in gross annual income was also found to have a positive contribution in minimizing the levels of vulnerability. It can be argued that households with more income can purchase modern inputs, introduce new technologies, and invest in diverse livelihood sources so as to boost their productivity and protect themselves against any odds of climate variability. Our findings again corroborate with a study finding that was obtained from Eastern Ethiopia (Lemma & Wondimagegn, 2014). Somewhat related to increased income is access to credit services, in which only 28.2% of the total respondents had access. The survey finding was also confirmed by

focus group discussants and key informants of the study. The problem related to such limited access is that households are forced to accept high interest loans from private money lenders, which may make them gradually get caught up in a debt spiral. Furthermore, due to the limited access to credit services the rural households are denied the benefits they could receive, such as using new technology packages, investment in diversification, and others.

The finding on levels of vulnerability according to gender has revealed that female-headed households are better relative to their male counterparts. This may suggest that the vulnerability of some households to food insecurity could be reduced meaningfully by focusing on providing more access to non-farm income, availing farm equipment, improving access to credit, and providing well targeted assistance by formal institutions. Likewise, a lower incidence of food insecurity for the female headed households than that of the male-headed ones was found by Abebaw and Ayalneh (2007). To the contrary of our finding, a study conducted in Nigeria by Babatunde and colleagues (2008) has found that female headed households are more vulnerable to food insecurity than male headed households, due to differential access to assets.

It can be observed from the final output of the vulnerability index that the combined effects of sensitivity and exposure exceed the adaptive capacity of households for more than half of the total respondents who participated in the survey. This can be evidenced with the significantly large number of respondents who witnessed the occurrence of extreme weather events and the concomitant problems manifested in terms of food and water shortage. In similar terms, it was observed by Karfakis *et al.* (2011) that even small variations in temperature have heavy effects on the farmers' future ability to access sufficient food. Likewise, households are more vulnerable over time owing to insufficient rebuilding of assets after each successive shock (Ellis *et al.*, 2009). Indeed, it can be deduced that the future prospect of food security for those who were highly vulnerable is worrisome. It must be implied that more work is needed in terms of lessening the sensitivity of households and building their adaptive capacity. To this end, it was succinctly elaborated that building the owned assets and broadening the livelihood options could enhance a households' flexibility, which would enable them to flourish in good times, sustain through stress, and rebuild after some shocks (Ribot, 2010).

3.6 Conclusion and Recommendation

This paper was aimed at examining the levels of vulnerability to food insecurity for rural households. Through the integrated vulnerability assessment approach, the households' levels of vulnerability were measured, which revealed that more than half of the total respondents were highly vulnerable. This may show that a large number of the rural households either did not have the required assets to minimize their vulnerability, or that their asset bases were already depleted. It was also obtained across the sample *kebeles* that a statistically significant difference exists in terms of vulnerability levels (at $p< 1\%$). Consequently, significantly high proportions of households (86.2%) in *Q/H/Mirqasa kebele* were highly vulnerable to food insecurity, compared to 14.3% of respondents in *Buta Wagare kebele* who fell into a similar category. This could be because of the higher influence to the exposure indicators (increased temperature, frequent drought, and inadequate overall rainfall) and the concomitant problems that were expressed in terms of sensitivity (food shortage, water scarcity, and incidence of conflict over resources). Moreover, results showed that, despite the fact that the overall vulnerability level was dismal, female-headed households were better relative to the male-headed households in each of the categories of the vulnerability to food insecurity. Therefore, to reduce the likely adverse effects, the local authorities and non-governmental organizations operating in the area must concentrate on the adaptive capacity of households. This is because these stakeholders can have a relatively meaningful influence over the indicators of this component. Furthermore, for the sake of the efficient use of the meager resources, decision makers and other stakeholders may need to prioritize their interventions according to the levels of vulnerability. Finally, for practical applications and a wider impact, our study suggests the need to consider the time dimension of vulnerability when conducting future research.

Chapter 4: Food Insecurity of Rural Households in Boset District, Ethiopia: An Examination through a Suite of Indicators

Abstract

Food insecurity is still a big problem in Ethiopia despite all the efforts made to improve the overall situation. This study examines the food insecurity situation, and identify their determinants for the rural households of Boset District. A total of 397 household heads were selected through systematic sampling technique from six sample *kebeles.* In addition, focus group discussions, key informant interviews, and personal observations were utilized as complementary methods. The food insecurity status of households was measured on the basis of Months of Adequate Household Food Provisioning (MAHFP), Household Food Insecurity Access Scale (HFIAS), Household Dietary Diversity Score (HDDS), and access and use of Water Supply, Sanitation and Hygiene (WASH). The results revealed that 26.5%, 21.7%, and 41.3% of respondents were *most* food insecure according to measurement through MAHFP, HFIAS, and HDDS, respectively. Some 56.9% of the respondents did not have access to water supply, 46.1% not owned latrine, and 64.0% dispose waste in unsafe way. Results from the inferential statistics showed that out of the total variables considered 9 of them have statistically significant effects. Accordingly, educational status, farmland size, total annual income, distance from health facilities, and availability of supporting organizations were found to positively contribute to food security. Conversely, access to irrigable land, frequent drought, distance from input/output markets, and distance to road transport were found to negatively affect food security. It can be learned that in all the dimensions of food (*in*)security the situation is disappointing. Hence, to be more effective interventions shall focus on those determinants with special emphasis on the variables which have either positive or negative associations with food security. The study also suggests the need to consider the time dimension of food insecurity when conducting future research on similar topic.

Keywords: Food insecurity, determinants, suite of indicators, Boset, Rural Ethiopia.

4.1 Introduction

The issue of where our next meal comes has bedeviled humankind for much of our existence (Peacock, 2012); thus, food insecurity is a daily reality for hundreds of millions of people around the world (Webb *et al.*, 2006). In our today's time, one can observe our world's population living in a situation where there are serious strains. Thus, it was illustrated that "a threefold challenge now faces the world: match the rapidly changing demand for food from a larger and more affluent population to its supply; do so in ways that are environmentally and socially sustainable; and ensure that the world's poorest people are no longer hungry" (Godfray *et al.*, 2010). Furthermore, it was predicted that "it seems incontrovertible that we are facing a global paradox, such that by 2030, we will have to produce more food with less water to feed approximately another billion people" (Chartres & Sood, 2013, p.4).

A closer look at the Ethiopian context depicts that the food insecurity problem is an issue which deserves special attention to be tackled. Different scholars have shown that food insecurity has been a daunting challenge to Ethiopia (Degefa, 2005; Messay, 2012; Meskerem & Degefa, 2015; Belay & Dawit, 2017). In recent years, commercial food import and food aid have been accounting for a *significant* proportion of the total food supply in the country (Belay & Dawit, 2017). Due to such high dependence on food import, Ethiopia is vulnerable to uncertainties of food import from the international market (Berhanu, 2004). Moreover, it was confirmed that, despite the attempts made to improve the food security situation, the *actual* number of people exposed to food shortages in Ethiopia has remained significantly high (Guyu, 2015).

Oromia Bureau of Agriculture (2014) indicated that the food insecurity situation in Boset district was so precarious. Relatedly, the bureau revealed that due to the fact that Boset district is prone to frequent drought, it was included in the Productive Safety Net Program (PSNP). A district could be included in the PSNP when confirmed by experts that there prevails chronic food insecurity situation. In the Ethiopian fiscal year of 2014/2015 there were 58,131 households who were beneficiaries from the PSNP in East Shewa Zone.

Given the fact that food insecurity is a real challenge for the life and livelihood of Ethiopia, and the study area in particular, a further study can be justified on many grounds. To begin with, it was mentioned that food security matters immensely, because the consequences of food insecurity can affect almost every facet of society (Jones *et al.*, 2013). In addition, the

International Food Policy Research Institute [IFPRI] (2002) highlighted that food insecurity situation is a human tragedy on a vast scale, made even more heartbreaking because it is avoidable. Schanbacher (2010) also mentioned that if food sovereignty's demands are not met, it constitutes a massive violation of human rights; in geopolitical terms, deeper food crisis will undoubtedly engender more collective insecurity (Behnassi & Yaya, 2011); and, taking statements of former US President Obama at the 2012 G8 Summit, it was indicated that food security is "an economic imperative" since a poorly nourished population is a less economically productive one (Jones *et al.*, 2013).

Coming to terms with the above discussed rationales, the concept of food (*in*)security need to be operationalized so that a common understanding could be reached. This is because food (*in*)security is a dynamic phrase having so many definitions emerging overtime (Maxwell, 1996; Carr, 2006; FAO, 2009). Food (*in*)security has evolved from a focus on availability of food, to access and utilization, and to stability in all dimensions (Conceicao *et al.*, 2016). Notwithstanding all the contentions and varying definitions of food security over time, now scholars seem to agree on the comprehensive definition given on the World Food Summit of 1996. Accordingly, the definition which is also adopted in this paper states that:

> Food security exists when all people at all times have physical or economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 2008b).

From this definition one can identify four key dimensions of food security: availability of sufficient food; economic, physical and social access to the resources needed to acquire food; stability of this availability and access; and utilization that include nutrition, food safety and quality, clean water and sanitation (Schmidhuber & Tubiello, 2007; Carletto *et al.*, 2013; Poppy *et al.*, 2014; FAO, 2016b). Consequently, it can be deducted that food insecurity could result if one or more of the key dimensions fail to be fulfilled (Du Toit & Ziervogel, 2004; Jones *et al.*, 2013).

So far there were so many research works conducted in different parts of Ethiopia on food insecurity. However, majority of the research works conducted (to mention few Abebaw & Ayalneh, 2007; Guyu, 2014; Tewodros & Fikadu, 2014; Guyu & Muluneh, 2016) used a single indicator (mainly food balance model or calorie availability) to measure the food insecurity

situation which could capture only a portion of the whole situation. Such an approach, however, could underestimate the prevalence of food insecurity and its consequences; make the diagnostics difficult; and lead to the design of "one-size-fits-all" interventions (Coates, 2013). That is why our paper deviates from that traditional way of studying food insecurity by employing multiple indicators so that the situation could be understood comprehensively. Of course, the use of a suite of indicators is a call of the time which was advocated by authoritative organizations like FAO, IFAD, and WFP (2013) and leading scholars such as Carletto *et al.* (2013), Coates (2013), to mention few.

Therefore, it is based on the existing high prevalence, recurrence of food insecurity, and the need to study food insecurity in a comprehensive way that this paper was conceived. The paper aims to analyze the food insecurity situation of the rural households in Boset district, which has been a hot spot for food assistance for a long period of time. In fact, identification of determinants of the food insecurity in the study area was the other aim of the study. Thereby, this study could build on similar findings on the topic and would enable to understand food insecurity in its multi-dimensionality.

4.2 Theoretical Framework

There have been so many theories proposed to explain about food insecurity. In fact, the explanatory powers of those theories depend on the time and existing situation of a particular place. Moreover, having recognized the existence of multiple theories of food insecurity, it was contended that among the different theories of famine (*food insecurity in this case*) no single theory is dominant or capable of excluding the others (Wisner *et al.*, 2004). Cognizant of this fact, we used three of the existing theories to explain the food insecurity situation of the study area.

The first theory considered is the political economy explanation which describes that "the lack of political conditions for an anti-famine contract revolve around anti-democratic tendencies that abrogate any existing democratic rights, thereby hindering timely and effective action to prevent famine, and can therefore be said to involve a famine crime" (Wisner *et al.*, 2004). This approach attributes food insecurity occurrence, whatever the economic or natural shocks, to governments' incompetence and lack of commitment at best, or to a deliberate action or inaction at worst (Ali, 2008). Similarly, Devereux (2001) argued that "all famines are explained by a combination of

'technical' and 'political' factors, where political factors include bad government policies, failure of the international community to provide relief, and war". Thus, the political economy explanation suggests that whenever incumbent government authorities and even donors are not delivering what they ought to, food insecurity or famine (in the extreme case) could happen.

Second, the climatic and environmental theory that deals with the fact that food insecurity happened with the possible increase of extreme events, in which natural hazards are magnified in intensity and frequency (Wisner *et al.,* 2004). It was also illustrated that "a combination of arable land lost to population pressure, deforestation and overgrazing, together with the possibility of a long-term decline in rain-fall in dryland farming areas in Africa and Asia, will cause declines in crop production and exacerbate food insecurity" (Devereux, 2001). In a similar vein, it was stated that this approach considers drought (sometimes floods) and recently climate change factors in the explanation of disruption or reduction of food output, which may at the end result in food insecurity (Ali, 2008).

The third theory is concerned with food insecurity as an outcome of vulnerable livelihood. Accordingly, this theory gives explanation in the sense that food insecurity could result when households fail to secure access to the various forms of assets, or when the mediating processes (i.e. institutions, organizations and social relations at work) are not serving what is expected and/or a combination of these factors when interacting with the existing context (history, trends and vulnerability/shock) (Degefa, 2005).

4.3 Methods

4.3.1 Description of the study area

Boset district extends between $8^0$24'- $8^0$51' North latitude and $39^0$16'- $39^0$50' East longitude. It is located in the northeast part of East Shewa zone, Oromia National Regional State. It is bordered with Adama district in the west; by Amhara National Regional State in the north; by Fantale district in northeast and by Arsi zone in southeast. Based on the results of National Population and Housing Census of Ethiopia conducted in May 2007, a population projection was made for all Regions and Districts from 2014 – 2017. Accordingly, data obtained from Central Statistical Agency [CSA] (2013) indicated that the total population of Boset district for the year 2017 was

projected to be 189,795 out of which 42,793 (22.5%) are urban population and 147,002 (77.5%) are rural population.

Based on a report obtained from the district's Finance and Economic Development Office (2012), Boset district is located in the midst of the Great Rift Valley, which extends from the North to South of the district. Climatically, most parts of the district (about 89%) belong to tropical (*kolla*) agro-climatic zone and the remaining small section (about 11%) is sub-tropical (*woina dega*). The district is characterized by hot and dry weather with an average annual temperature which varies between 25 – 30^0C for the tropical (*kolla*) and 15 – 20^0C for the sub-tropical (*woina dega*). The rainfall is weakly bi-modal with spring (a small rainy season) during the months of April and May while summer (a long rainy season) during the months of July - September. The average annual rainfall ranges between 700 – 800 mm with the intensity and variability being high in the district. In terms of drainage system, the district falls in the Awash River Basin, with no other major streams and lakes. As a result, there was acute water problem for livestock and people.

4.3.2 Research design and data collection

This study was conducted in Boset District, East Shewa zone of Oromia National Regional State. It was undertaken as a cross-sectional survey using mixed methods research approach. The choice of mixed methods was dictated by the research problem under investigation and to benefit from the merits of using this research approach (Creswell, 2009; 2012; Creswell & Clark, 2011).

In terms of sources of data, both primary and secondary sources were utilized. The primary data were generated by employing household survey which was administered by 12 Development Agents (DAs) who are familiar to the study area and conversant with the local language (Afan Oromo). After pretesting and fully developing the structured questionnaire, it was administered face-to-face. Key informant interviews (KIIs) were also held with heads of offices and focal persons from health, women's and children's affairs, water resources, irrigation, crop production, livestock production, natural resources management, disaster preparedness and prevention, World Vision Ethiopia (Boset Area Development Program), and community elders living in the sample *kebeles*.

Similarly, focus group discussions (FGDs) with selected 6 men's and 4 women's groups were conducted separately with members comprising 6-10 individuals. The groups were formed on volunteer basis with the help of the DAs working in the respective sample *kebeles*. The criteria for inclusion in the group discussion were household heads lived in the *kebele* for more than 5 years and some knowledge on food insecurity issues. Lastly, personal observations coupled with informal discussions were also employed to generate primary qualitative data. In addition, we have utilized current and relevant journal articles which were mainly published within the last ten years as sources of secondary information.

To have a full picture of the district, a total of 6 *kebeles* located at different places were selected by district level experts. Food insecurity status, access to irrigation facilities, and participation in the Productive Safety Net Program (PSNP) were used as criteria for selecting the sample *kebeles*. The PSNP was used as one criterion to get those *kebeles* which are chronically food insecure, this is because it is only 10 *kebeles* of the district under the PSNP. Otherwise, it was not the intension of this study to assess the impacts of PSNP.

List of households living in each of the selected *kebeles* was taken as a sampling frame, then respondents were selected using systematic random sampling technique proportionate to the size of households living in each *kebele*. The systematic random sampling technique was employed because it is one of the probability sampling methods and is easy to manipulate during selection of the sample households (Babbie, 2008; Bryman, 2012). Using the formula illustrated by Israel (2013), the sample size was calculated which resulted in a total of 397 participants (48 female- and 349 male-headed households). In the determination of the sample size, a 95% confidence level and a *p*-value of .05 for maximum variability were assumed.

Mathematically, the formula is presented as:

$$n = \frac{N}{1 + N(e)^2}$$

where *n* stands for the sample size, *N* signifies the total number of households in all the *kebeles*, *e* designates maximum variability which is 5% (0.05), and 1 stands for the probability of the event occurring.

4.3.3 Data analysis

Food insecurity analysis

Based on the nature of the variables measured, to analyze the data collected both descriptive and inferential statistics were employed. Accordingly, to measure the food insecurity status through different indicators, sources of food for households, and mechanisms of filling food gaps we have mainly used percentages, mean, and standard deviation. The final analysis of the quantitative data was done using STATA v. 12. In addition, results of the FGDs, KIIs, and the field observations were transcribed and analyzed according to themes which emerge.

Different authors and organizations have suggested the necessity to comprehensively analyze the four dimensions of food (*in*)security (see Carletto *et al.*, 2013; FAO *et al.*, 2013), and to use a suite of indicators to capture the complex realities of food insecurity (e.g. Carletto *et al.*, 2013; Coates, 2013; Leroy *et al.*, 2015). This is because each measure captures and neglects different phenomena intrinsic to the concept of food security, thereby subtly influencing prioritization among food security interventions (Barrett, 2010).

Following those suggestions, the indicators we employed include: the identification of Months of Adequate Household Food Provisioning (MAHFP); Household Food Insecurity Access Scale (HFIAS); Household Dietary Diversity Score (HDDS); and, assessing the access and use of water supply, sanitation and hygiene (WASH) facilities. These indicators are preferred taking into account issues like accuracy, speed, and cosistency as suggested by Maxwell *et al.*, 2014.

According to Bilinsky and Swindale (2010), when using the MAHFP, although the response options start with the month of January, the respondent was asked to think back over the previous 12 months, starting with the current month. This was done by adjusting the months according to when one conducts the survey so that the current month appears first. Hence, respondents could be asked to identify in which months (during the past 12 months) they did not have access to sufficient food to meet their household needs. The purpose of these questions is to identify the months in which there is limited access to food regardless of the source of the food (i.e., production, purchase, barter or food aid) (Bilinsky & Swindale, 2010).

Based on information obtained from Namana and Souli (2007) and making some modifications, households were classified into three categories of food insecurity: least food insecure which

includes households that reported being able to satisfy their food requirement for 10-12 months; moderately food insecure includes households that were able to satisfy their food needs for 7-9 months of the year; and, most food insecure includes households that cannot feed their household members for six and more months during the previous year.

The second indicator to food insecurity measurements based on subjective responses is HFIAS (Carletto *et al.,* 2013). The HFIAS is based on the idea that there are a set of predictable reactions to the experience of food insecurity that can be summarized and quantified, allowing for measurement through household surveys (Coates *et al.,* 2007; Carletto *et al.,* 2013).

It was indicted that the HFIAS has a set of nine questions which represent universal aspects of the experience of food insecurity, capturing information on food shortage, food quantity and quality of diet to determine the status of a given household's access to food (Carletto *et al.,* 2013). In addition, households and populations can be classified according to the severity of their food security status along a spectrum, by using data on the severity and frequency of their experiences over the previous 30 days (Carletto *et al.,* 2013).

Based on the description given by Coates *et al.* (2007), the maximum score for a household is 27 (the household response to all nine frequency-of-occurrence questions was "often", coded with response code of 3); the minimum score is 0 (the household responded "no" to all occurrence questions, frequency-of-occurrence questions were skipped by the interviewer, and subsequently coded as 0 by the data analyst). The higher the score, the more food insecurity (access) the household experienced. The lower the score, the less food insecurity (access) a household experienced.

The HDDS, as a third indicator, is calculated by summing the number of unique food groups consumed during the last 24 hours (Carletto *et al.,* 2013). The value of this variable will range from 0 to 12, in which lowest HDDS value signifies higher food insecurity status and vice versa. Even though there is no international consensus on which food groups to include in the scores (FAO, 2010), the HDDS denotes 12 food groups in which the following were considered in this study: cereals; root and tubers; vegetables with tubers; vegetables which are leafy; fruits; meat, poultry, offal; eggs; fish; pulses/legumes/nuts; milk and milk products; oil/fats; and sugar/honey.

Based on the findings from a review of different studies made by Ruel (2003) and Faber *et al.* (2009) the cutoff point for the HDDS in this study was made that HDDS ≤ 5 represent low dietary diversity, HDDS 6-7 for medium, and HDDS ≥ 8 for high dietary diversity. This categorization could signify, most food insecure, medium food insecure, and food secure, respectively.

To obtain a complete picture of the factors that ultimately determine the food insecurity status of a given household, non-food factors were also considered. This is because the various non-food factors are known to contribute to determine level of the food insecurity outcomes (Carletto *et al.* 2013). Accordingly, access to basic services such as clean water and sanitation together with their use were considered in this study.

Hence, based on review of the empirical studies, the MAHFP is used to assess the availability dimension, HFIAS to examine the access dimension, HDDS to measure the quality/utilization (Ruel, 2003; Carletto *et al.*, 2013; Headey & Ecker, 2013), and WASH also to assess the utilization dimension (Bashir & Schilizzi, 2013). The stability dimension, however, could be captured by looking into the results of the other three components, as it cuts across all these dimensions (Carletto *et al.*, 2013; FAO *et al.*, 2014).

Specification of the logit model

To identify the determinants of household food (*in*)security a binary logistic regression model was used. The dependent variable in this model is the result obtained from the HDDS value as measured by counting the food groups that households have consumed during the last 24 hours of the study period. Households with HDDS ≥ 8 are food secure and those with HDDS < 8 are food insecure. Whereas the independent variables constitute gender, age, educational status, household size, participation in non-farm activities, farmland size, access to irrigable land, total annual income, notice frequent drought and flood occurrence, access to weather forecast, availability of *kebele* assistance, access to agricultual extension services, access to health extension services, access to credit services, distance to input/output markets, distance to road transport, distance to health services, and availability of other (NGO) support organizations.

Following the works of Gujarati (2004) and Tewodros and Fikadu (2014) the functional form of the logistic model is presented as follows:

$$P_i = E\left(Y = {}^{1}/_{X_i}\right) = \frac{1}{1+e^{-(\beta_o+\beta_j X_i)}} \quad (4.1)$$

Substituting $(\beta_o + \beta_j X_i)$ by Z_i, the equation would become:

$$P_i = \frac{1}{1+e^{-Z_i}} = \frac{e^{Z_i}}{1+e^{Z_i}} \quad (4.2)$$

Where:

$P_i = E(Y = 1)$ is the probability that a household is food secure.

z_i is a set of explanatory variables of the i[th] household.

$\beta_o \; and \; \beta_j$ are the parameters to be estimated.

If P_i is the probability that a household is food secure, as is given in Eq. 4.2, the probability of food insecurity is then expressed as:

$$1 - P_i = \frac{1}{1+e^{Z_i}} \quad (4.3)$$

From this, the odds ratio in favor of food security thus could be:

$$\text{The Odds ratio} = \frac{P_i}{1-P_i} = \frac{{}^{e^{Z_i}}/_{1+e^{Z_i}}}{{}^{1}/_{1+e^{Z_i}}} = e^{Z_i} \quad (4.4)$$

Since, logit model uses logarithmic transformation to assume linearity of the outcome variables on the explanatory variables, the specific logit model to predict the odds of household food security is given in Eq.5.

$$\ln\left[\frac{P_i}{1-P_i}\right] = Z_i = \beta_0 + \beta_j X_i + \varepsilon_i \quad (4.5)$$

Where β_0 is the constant, and β_i where i = 1, 2,… j are the coefficients of the exogenous variables to be estimated. X_i is a vector of the explanatory variables.

Following is a table that gives a brief description of the variables hypothsized to affect food security of the study area.

Table 4.1 Variables hypothesized to affect food security in the study area

Explanatory variables	Description	Expected sign
Gender	Dummy takes the value of 1 if male and zero otherwise	+
Age	Continuous	+
Educational status	Dummy takes the value of 1 if formal education and zero otherwise	+
Household size	Continuous	-
Participation in non-farm activities	Dummy takes the value 1 if there is access and zero otherwise	+
Farmland size	Continuous	+
Access to irrigable land	Dummy takes the value 1 if there is access and zero otherwise	+
Total annual income	Continuous	+
Noticed frequent drought	Dummy takes the value 1 if they have noticed and zero otherwise	-
Noticed frequent food occurrence	Dummy takes the value 1 if they have noticed and zero otherwise	-
Access to weather forecast	Dummy takes the value 1 if there is access and zero otherwise	+
Availability of *kebele* assistance	Dummy takes the value 1 if there is access and zero otherwise	+
Access to agri. extension services	Dummy takes the value 1 if there is access and zero otherwise	+
Access to health extension services	Dummy takes the value 1 if there is access and zero otherwise	+
Access to credit services	Dummy takes the value 1 if there is access and zero otherwise	+
Distance from input/output markets	Continuous	-
Distance to road transport	Continuous	-
Distance to health services	Continuous	-
Availability of other (NGO) support organizations	Dummy takes the value 1 if there is access and zero otherwise	+

4.4 Results and Discussion

4.4.1 Food insecurity as measured by MAHFP

The availability dimension of the food insecurity of the respondents as measured by the MAHFP indicate that only 8.3% of them were least food insecure, 65.2% moderately food insecure, and 26.5% most food insecure (Table 4.2).

Table 4.2 Number of Months respondents consume their own produce by *kebele*

Name of *kebele*	Number of months						Total	
	3-6 months		7-9 months		10-12 months			
	n	%	*n*	%	*n*	%	*n*	%
Buta Wagare	3	14.3	11	52.4	7	33.3	21	100.0
D/Wanga	9	30.0	13	43.3	8	26.7	30	100.0
Q/H/Mirqasa	50	31.3	100	62.5	10	6.2	160	100.0
Sara Areda	5	9.6	47	90.4	0	0.0	52	100.0
Sifa Batte	30	27.8	75	69.4	3	2.8	108	100.0
Tiri Birreti	8	30.8	13	50.0	5	19.2	26	100.0
Total	105	26.5	259	65.2	33	8.3	397	100.0

Pearson chi2(10) = 58.5444 Pr = 0.000

Results from Table 4.1 show across all the *kebeles* majority of respondents fall in the category of 7-9 months (moderately food insecure). The statistical test conducted also shows there was statistically significant difference (at $p< 0.01$) in terms of the number of months respondents encountered food insecurity across the sample *kebeles*. For example, there was no respondent from *Sara Areda kebele* who fall in the least food insecure category as compared to 33.3% of the respondents in *Buta Wagare kebele*. Here it can be learned that interventions aimed to tackle food insecurity in the study area should consider the severity level of the problem.

In line with what was obtained in the survey, key informants and focus group discussants also indicated that food insecurity occurs on seasonal basis. In the words of the focus group discussants "always after Ethiopian Easter is celebrated" food insecurity occurs in most of the *kebeles* in the study area, which shows a cyclical pattern of inadequate availability and access to food. Focus group discussants in four of the sample *kebeles* (except *Sifa Batte* and *Q/H/Mirqasa*) expressed the months June to September were those in which they experience the worst food shortage of the other months. Related to the cyclical pattern of food insecurity, the finding may signify a need for mechanisms to be designed in order to avoid the depletion of resources while trying to compensate for the diminishing access to food.

As far as the consequence of the months of inadequate food provisioning is concerned, it was highlighted that seasonality and being food deficit from own production even in normal years, can be implicated in making people less than food secure (Ellis, 2003). It can also be deducted that the stability component of the respondents' food security could be highly compromised. This

is because, "stability in the availability of and access to food should be ensured regardless of sudden shocks like climatic crisis or cyclical events which involve seasonal food scarcity" (FAO, 2016b).

To fill the gap that was created from consuming own production, opportunities of earning income from nonfarm activities are so important. However, it was only 15.1% (*n*=60) of the households who reported to have engaged in different nonfarm income generating activities. Given such limited opportunity for generating income outside their farming, one can imagine what the food insecurity situation could look like, especially for those who were consuming their own produce for only 3-6 months.

Of course, households could have different sources of food for their consumption. Understanding the basic patterns of the sources and how they vary across locations, population groups, and over time will provide a particularly important starting point for understanding the general nature of the food security problem (Frank *et al.*, 1999). Accordingly, households have identified different sources of food as indicated in Table 4.3.

Table 4.3 Sources of food for the households (Multiple responses)

Sources of getting food	**Responses**		**Percent of Cases**
	n	**Percent**	
Get from their own production	397	44.4	100.0
Get from purchase	251	28.0	63.2
Get their food through aid	160	17.9	40.3
Get their food by borrowing	87	9.7	21.9
Total	895	100.0	225.4

Results from Table 4.3 show all of the households obtained food from their own production. This is just because they were engaged in farming activities. Next to that is obtaining food by purchase (63.2%), getting through aid (40.3%), and through borrowing (21.9%). It can be learned that one source of getting food was not adequate to feed the whole family members throughout the year. Again it can be seen that more than half of the respondents replied to have obtained food from purchase, that issue of price fluctuation and market in general are important factors that merit special attention when dealing with food insecurity in the study area. This is because "given the heavy dependence of both the rural and urban poor on markets, inflation has potentially devastating effects on the food security of poor households" (Ministry of Agriculture

and Rural Development [MoARD], 2009). Similar argument was also made by van Ittersum and Giller (2014) that price fluctuations could have negative impact on the food purchasing power of consumers that are both rural- and urban-poor households.

Furthermore, it was demonstrated that particularly for the poor, who spend more than 50% of their income on food consumption, changes in the prices of major staple crops can have a dramatic impact (Wheeler & von Braun, 2013; Kristkova *et al.*, 2016). Likewise, scholars have again expressed that increase in food prices could have both direct impacts and reductions in real incomes for poor consumers who spend a large share of their income on food that will inhibit their access to available food (Ringler *et al.*, 2010; Jones *et al.*, 2013).

It can also be seen that getting food through borrowing has the least contribution as can be seen from Table 4.3. This could be partly because, according to focus group discussants, the ever increasing poverty of the rural residents and the monetization of everything have eroded the value of supporting each other among the community members.

Since majority of the households were not found to have consumed only from their own produce throughout the year, and the unavailability of income diversification opportunities could indicate the existence of food gaps. Hence, findings about the mechanisms of filling food gaps from Table 4.4 show the rural households used different mechanism of filling food gaps.

Table 4.4 Mechanisms of filling food gaps (Multiple responses)

Food gap filling	**Responses**		**Percent of Cases**
	n	**Percent**	
Fill food gap through aid	128	19.8	33.5
Fill food gap through borrowing	90	14.0	23.6
Engage in food for work	158	24.5	41.4
Engage in non-farm activities	60	9.3	15.7
Engage in casual labor	142	22.0	37.2
Fill food gap through remittance	67	10.4	17.5
Total	645	100.0	168.9

The finding (Table 4.4) shows multiple mechanisms that households used to fill the food gaps they were confronted with. However, non-farm activities, remittance, and borrowing contribute relatively minimum. Besides, most of the mechanisms used by respondents appear to be unreliable.

Looking closely at the mechanisms of filling food gaps, some of them need to be treated with special precautions as their end result may not be the one which was intended. During the study period, it was observed that so many households including those considered to be better came to the district agriculture office to complain about their exclusion from benefitting out of the PSNP. Even at times of informal discussions with residents in the district, people told that overcoming the food insecurity problem without the PSNP is unthinkable. Besides, staff members of the food security team in the district mentioned the difficulty of discriminating households who are going to graduate from the program, as there was no one who wants to graduate.

Related to what was physically observed and highlighted by the district staff members, one of the mechanisms that deserve careful handling is food aid. On this issue different scholars advised to handle food aid with caution. For instance, it was reported that food aid is one of the oldest forms of foreign aid and one of the most controversial (FAO, 2006). Similarly, Barrett (2006) mentioned "while there is effectively universal agreement as to the desirability of the goal of reducing acute and chronic food insecurity, there remains considerable dispute as to how effective food aid is in achieving the goal". It was emphasized that the undesirable aspect, 'negative dependency', which arises when meeting current needs comes at the cost of reducing recipients' capacity to meet their own basic needs in the future without external assistance (Barrett, 2006). In addition, the negative dependency typically arises when individuals, households or communities alter their behavior in response to the provision of assistance that unwittingly creates disincentives to undertake desirable behavior (Barrett, 2006).

In line with the argument made in the preceding paragraph, it was explained that "food aid dependency undermines food security in Ethiopia at every level, from the household to the national government" (Devereux, 2000). This is because the government has little incentive to expend its scarce resources on food security programs as long as the international community remains willing to sink its food surpluses into Ethiopia (Devereux, 2000). Similarly, even very recently it was depicted that "despite the existence of the PSNP, there has not been a reduction in food aid to Ethiopia. In fact, the 2015 appeal issued by the Government of Ethiopia and humanitarian partners is one of the biggest ever at 1.4 bn USD" (Sandstrom & Juhola, 2017).

Box 1. Reflection of a key informant from World Vision Ethiopia of Boset district. The key informant stated that engaging in daily labor (Merti and Africa Juice companies), charcoal making and firewood selling, petty trading, renting out land with cheap price, diversifying income sources through irrigation, and taking credit from private money lenders were the mechanisms through which the local people fill the food gap created.

As far as food gap filling mechanisms is concerned, it can be deducted that some of the mechanisms, such as food aid, charcoal and firewood selling, and renting out land could result in undesirable results that call for a critical review of the country's strategy. This is because, community members (in the case of the study area) and even nations could fall addicted to such quick fixing but downgrading way of solving a problem.

4.4.2 Food insecurity as measured by HFIAS

Based on the nine generic questions (as indicated in Table 4.4) of the access-related conditions, the finding shows it was only 26.2% (*n*=104) who never worried having not enough food, whereas the remaining 73.8% (*n*=293) of surveyed households have experienced problems of both economic and physical access to food at varying levels of food insecurity.

Table 4.5 Distribution of households by HFIAS Condition

S/n	HFIAS Conditions	Severity status and number of households					
		Rarely		Sometimes		Often	
		n	%	*n*	%	*n*	%
1	Worried having not enough food	152	51.88	129	44.03	12	4.10
2	Not able to eat the food kinds s/he preferred	55	13.90	212	53.81	127	32.23
3	Able to eat only a limited variety of foods	6	1.52	167	42.39	221	56.09
4	Able to eat some foods that s/he did not want to eat	195	68.18	89	31.12	2	0.70
5	Able to eat a smaller meal than s/he felt needed	47	11.93	208	52.79	139	35.28
6	Able to eat fewer meals/day b/c there was not enough food	17	4.33	165	41.98	211	53.69
7	Absolutely no food to eat in the household	178	69.80	77	30.20	0	0.00
8	Slept at night hungry b/c there was not enough food	95	73.08	35	26.92	0	0.00
9	Went a whole day and night hungry b/c there was not enough food	58	85.29	10	14.79	0	0.00
	Total score	803	30.8	1092	41.9	712	27.3

Clues to the severity status
1) Rarely (once or twice in the past four weeks)
2) Sometimes (three to ten times in the past four weeks)
3) Often (more than ten times in the past four weeks)

Looking at the finding on the basis of the severity level, out of the total score of 2607, it can be observed that 30.8% of households encountered access problems 'rarely', 41.9% 'sometimes', and 27.3% 'often' during the last one month of the study period.

Furthermore, the finding shows the mean score of HFIAS for the households was 12.9 with a standard deviation of 4.3 while the minimum and the maximum were 1 and 22, respectively. Based on the categorization made by FAO (2008a) on a study conducted in Mozambique to determine the cutoff point, a score of 0-11 was taken as "most food secure"; 12-16 medium food insecure; and a score above 16 most food insecure. Accordingly, it was found in this study that 39.8% (*n*=158) were most food secure; 38.5% (*n*=153) were medium food insecure; and 21.7% (*n*=86) were most food insecure.

Of course, the HFIAS is better interpreted when used to assess Household Food Insecurity Access Prevalence [HFIAP] (Guyu, 2015). Accordingly, the HFIAP indicator categorizes households into four levels of household food insecurity (access): food secure, and mild, moderately, and severely food insecure (Coates *et al.*, 2007). Thus, households were categorized as increasingly food insecure as they respond affirmatively to more severe conditions and/or experience those conditions more frequently. Results on the HFIAP are presented in Table 4.6.

Table 4.6 Distribution of households by household food insecurity access prevalence (HFIAP)

Question	**Frequency**		
	Rarely	**Sometimes**	**Often**
1a	152	129	12
2a	55	212	127
3a	6	167	221
4a	195	89	2
5a	47	208	139
6a	17	165	211
7a	178	77	0
8a	95	35	0
9a	58	10	0

Clue to the severity conditions:	
	Food secure /access/ = 9.4%
	Mildly food insecure /access/ = 27.2%
	Moderately food insecure /access/ = 33.8%
	Severely food insecure /access/ = 29.6%

Results of Table 4.6 show there were only few (9.4%) of the households who were food secure, i.e. such households experience none of the food insecure conditions, or just worry, but rarely.

To the contrary, the result shows there are 3 times more respondents who were severely food insecure, i.e. households already cut back on meal size or number of meals often, and/or experience some of the three most severe conditions.

4.4.3 Food insecurity as measured by HDDS

The results of the finding on the HDDS show respondents were found to have consumed an average of 6 food groups with a standard deviation of 1.53. Besides, the minimum HDDS value is 3 and the maximum HDDS value 11. The details of the HDDS value across the sample *kebeles* are presented in Table 4.7.

Table 4.7 HDDS for respondents' across the *kebeles*

HDDS	**Name of *kebeles***												**Total**	
	Buta Wagare		D/Wanga		Q/H/ Mirqasa		Sara Areda		Sifa Batte		Tiri Birreti			
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
3	0	0.0	1	3.3	15	9.4	0	0.0	3	2.8	0	0.0	19	4.8
4	0	0.0	3	10.0	33	20.6	2	3.8	11	10.2	7	27.0	56	14.1
5	5	23.8	6	20.0	55	34.4	8	15.4	10	9.3	5	19.2	89	22.4
6	6	28.6	5	16.7	41	25.6	11	21.2	26	24.1	7	27.0	96	24.2
7	6	28.6	5	16.7	14	8.8	14	26.9	37	34.2	4	15.4	80	20.1
8	2	9.5	3	10.0	1	0.6	12	23.1	17	15.7	1	3.8	36	9.1
9	2	9.5	6	20.0	0	0.0	5	9.6	4	3.7	1	3.8	18	4.5
10	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	1	3.8	2	0.5
11	0	0.0	1	3.3	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3
Total	21	100.0	30	100.0	160	100.0	52	100.0	108	100.0	26	100.0	397	100.0

Pearson chi2 (40) = 150.0694 Pr = 0.000

The statistical test made on the results of the overall HDDS shows there was a statistical significant difference across the sample *kebeles* about the HDDS at $p< 0.01$ with a degree of freedom which equals to 40. Hence, based on the categorization discussed earlier, about 41.3% of the respondents were found to consume less dietary diversity, implying they were more food insecure due to lack of the means to acquire and consume a variety of foods; those who have medium level of food insecurity account for 44.3%; and only 14.4% of the respondents have HDDS ≥ 8 that they were food secure and were able to acquire and consume a variety of foods. In fact, it should be noted that the HDDS value could be reduced if sugars and beverages are to be taken out, because they do not add to the nutritional quality of the diet (Faber *et al.*, 2009).

4.4.4 The nexus between WASH and food insecurity

When explaining how much water supply and sanitation practices are crucial, it was stated that populations suffering from hunger are often the same as those that lack adequate water and sanitation (Thompson *et al.*, 2012). Similarly, it was argued that ensuring poor people's access to safe drinking-water and adequate sanitation and encouraging personal, domestic and community hygiene will improve the quality of life of millions of individuals (Pruss-Ustun *et al.*, 2008). Moreover, safe drinking water, sanitation and hygiene (WASH) contribute significantly to the increased capacity of individuals to absorb and use the nutrients in their food (Rautanen & While, 2013).

Access to clean water

Access to safe drinking water has a direct contribution to the improvement of the food insecurity problem in different ways. Water is a key driver of agricultural production (Hanjra & Qureshi, 2010), and accessing safe drinking water has the benefits to reduce exposure to a variety of diseases that obstruct the intake and utilization of food and minimizing expenses related to health (Degefa & Tesfaye, 2008). In light of these facts households were asked about their access to safe drinking water and the responses are presented in Table 4.8.

Table 4.8 Whether respondents have access to safe drinking water by *kebele*

Name of *kebele*	Access to safe water				Total	
	No	**%**	**Yes**	**%**	***n***	**%**
Buta Wagare	18	85.7	3	14.3	21	100.0
D/Wanga	0	0.0	30	100.0	30	100.0
Q/H/Mirqasa	121	75.6	39	24.4	160	100.0
Sara Areda	42	80.8	10	19.2	52	100.0
Sifa Batte	43	39.8	65	60.2	108	100.0
Tiri Birreti	2	7.7	24	92.3	26	100.0
Total	226	56.9	171	43.1	397	100.0

Pearson chi2(5) = 120.2161 Pr = 0.000

Results from Table 4.8 show among the sample *kebeles* respondents of *D/Wanga* (100.0%), *Tiri Birreti* (92.3%) and *Sifa Batte* (60.2%) claimed to have better access to safe drinking water. Their access can be justified (for the first two *kebeles)* due to proximity to Wolanchity town, and for the third *kebele* proximity to *Bofa* (Gode Dhera) town. In the remaining sample *kebeles*, a

significant number of the respondents were not lucky to have access to safe drinking water, thereby forced to resort to other sources for drinking and other domestic purposes.

Findings of the six sample *kebeles* show that about 56.9% of the respondents did not have access to safe drinking water. During the FGDs participants informed that even those who have access did not feel the supply was reliable because the facilities were broken down frequently which forced them either to return back to the unsafe sources or spend lots of money to buy water for domestic purposes. When discussing how difficult it was getting safe drinking water, the discussants at *B/Wagare kebele* pointed out that one jerry can that holds 20 liters cost them 10 Birr after travelling 2 hours on foot. Coupled with the high price, the queue might be so long that sometimes it was in the second day that they could collect the water. A key informant interview made with head of the district's water resources office also confirmed water shortage is really a serious problem due to deepening of the water table and frequent break down of the existing facilities.

As to the implications of the above finding, it can be said, apart from the direct burden on households' health due to lack of safe drinking water, it has got so many negative consequences. For instance, it was mentioned that water availability will be one of the limiting constraints for crop production and food security (Kang *et al.*, 2009). In a similar vein, scholars have indicated that farmers' inability to access or control water has an obvious direct impact on potential yields and income, and an indirect impact by reducing potential payoffs from investments in fertilizers, improved seed varieties and learning technical skills (Giordano *et al.*, 2012).

In a broader way, it was illustrated that the lack of adequate water is linked to poverty – households facing water shortages are more likely to be poor or fall into poverty than households not facing such shortages (Faures & Santini, 2008). Thus, this could imply that households who lack access to water and those who are poor will be more vulnerable to food insecurity. And what is more frustrating is that water scarcity will become, more or less, a major threat to food security due to increasing food demand and competition for water resources among sectors (Chartres & Sood, 2013).

Among those households who did not get access to safe drinking water an attempt was made to distinguish their sources of drinking water. Accordingly, it was obtained that river/stream (95.6%) was their chief source of water. In fact, these unsafe sources could have detrimental

consequences particularly on the health of individuals and on their food security situation in general. Among the negative effects, it was said that lack of access to safe water could result in poor health and affect the physical wellbeing (Degefa & Tesfaye, 2008).

On top of what is discussed so far, in relation to the burden of collecting water for different purposes, FGDs held both with women's and men's groups admitted that collecting water is primarily the responsibility of women, followed by grown up children. This could imply that whenever women are forced to spend more time to haul water, it will reduce their productivity (Degefa & Tesfaye, 2008) that could end in keeping women in a poverty trap. In other words, investing large time to collect water and on other domestic chores could in fact put women in a 'time poverty' where there will be fewer opportunities to seek education and outside employment (Asian Development Bank, 2013).

Ownership and use of latrines

Among the WASH components one of them that was treated in this study is ownership and use of latrines. The findings from Table 4.8 show an interesting result in that, except in *Q/H/Mirqasa kebele,* in all the remaining *kebeles* latrines were owned by the large majority of the respective households.

Table 4.9 Respondents' ownership of latrine by *kebele*

Name of *kebele*	Ownership of latrine				Total	
	No	%	Yes	%	*n*	%
Buta Wagare	4	19.1	17	80.9	21	100.0
D/Wanga	2	6.7	28	93.3	30	100.0
Q/H/Mirqasa	139	86.9	21	13.1	160	100.0
Sara Areda	11	21.2	41	78.8	52	100.0
Sifa Batte	23	21.3	85	78.7	108	100.0
Tiri Birreti	4	15.4	22	84.6	26	100.0
Total	183	46.1	214	53.9	397	100.0

Pearson chi2 (5) = 181.6547 Pr = 0.000

Despite the ownership of latrines by majority of households, however, there was a problem when it comes to the use. FGDs in all the sample *kebeles* revealed that shortage of water to clean the latrine was bringing bad smell, as a result compelled members of households to defecate in unsafe places. A key informant interview held with the head of the district's health office also confirmed the weak usage of latrines due to shortage of water that could be used for cleaning. So the above percentage shows mainly the physical presence of latrines not necessarily their use.

Households who did not own latrine were also inquired to identify the area of defecation they used. Accordingly, about 70.0% (*n*=128) expressed to have used bushes and/or forest areas, whereas the remaining 30.0% (*n*=55) used open field for defecation. Because of such unsafe practice, the rural households could be denied of the benefits that one can obtain by having sanitation and hygiene facilities and good practices. To this end, scholars have illustrated that sanitation reduces or prevents human faecal pollution of the environment, thereby reducing or eliminating transmission of diseases from that source (Pruss-Ustun *et al.*, 2008). It was also demonstrated that high-tech solutions are not necessarily the best, some simple latrines can be very effective, while untreated sewage distributes pathogens in the environment and can be the source of disease (Pruss-Ustun *et al.*, 2008).

Mechanisms of waste disposal

With recognition of the fact that proper waste disposal could help to avoid disease creating pathogens, respondents were asked to identify the mechanisms they use.

Table 4.10 Respondents' mechanisms of waste disposal

Name of *kebele*	**Areas of waste disposal**						**Total**	
	Open field		In the garden		In a waste disposal pit			
	n	%	*n*	%	*n*	%	*n*	%
B/Wagare	5	23.8	3	14.3	13	61.9	21	100.0
D/Wanga	5	16.7	6	20.0	19	63.3	30	100.0
Q/H/Mirqasa	54	33.7	79	49.4	27	16.9	160	100.0
Sara Areda	13	25.0	23	44.2	16	30.8	52	100.0
Sifa Batte	38	35.2	19	17.6	51	47.2	108	100.0
Tiri Birreti	4	15.4	5	19.2	17	65.4	26	100.0
Total	119	30.0	135	34.0	143	36.0	397	100.0

Pearson chi2(10) = 69.9092 Pr = 0.000

Findings from Table 4.10 show only 36.0% of the respondents disposed waste in a waste disposal pit. The remaining 64.0% of the respondents disposed in unsafe way, either in an open field or in the garden. Such act of unsafe disposal of waste could play a role in transmission of diseases, which signify the need to be cautious about the surrounding environment where people are residing. This is because it was argued that it is insufficient for an individual to receive an adequate quantity of food, if he or she is unable to make use of the food due to illnesses resulting from inadequate sanitation or poor sanitary practices (Carletto *et al.*, 2013).

4.5 Determinants of food insecurity

As can be observed from Table 4.11 out of the 19 variables fitted in the binary logistic regression model 9 of them significantly affected food security status of the rural households in the study area.

Table 4.11 Parameter estimates of the binary logit model with their marginal effects

Explanatory variables	***Coefficients***	***P value***	***Marginal effects***
Gender	1.146024	0.119	0.074412
Age	-0.0012422	0.955	-0.0014243
Educational status	0.931175	0.032**	0.0962907
Household size	-0.0142931	0.883	0.0016966
Participation in non-farm activities	0.005792	0.990	-0.001335
Farmland size	0.9697931	0.000***	0.1142719
Access to irrigable land	-0.7562149	0.099*	-0.0926803
Total annual income	0.0000991	0.000***	0.0000112
Noticed frequent drought	-0.9546311	0.057*	-0.1109556
Notices flood occurrence	-0.2651678	0.535	-0.0221719
Access to weather forecast	0.8280069	0.413	0.0247848
Availability of *kebele* assistance	0.0351892	0.942	-0.0084927
Access to agri. extension services	0.7159894	0.185	0.0503655
Access to health extension services	0.2784892	0.556	0.035605
Access to credit services	-0.6171401	0.145	-0.0778475
Distance to input/output market	-1.676472	0.006***	-0.1401994
Distance to road transport	-0.842344	0.066*	-0.1036628
Distance to health services	1.812996	0.003***	0.1759557
Availability of other support organizations	0.9402377	0.048**	0.0597707
LR chi2(19)	103.46		
Prob > chi2	0.0000		
Pseudo R2	0.3167		

***,**,* Significant at 1%, 5%, and 10% probability level, respectively.

Educational status: The educational status of the household heads was found to be important in determining their food security situation. With a significance level of less than 5%, household heads with better educational status were more likely to be food secure with a 9.6% probability. This inverse relationship of educational status with food insecurity was also found in other empirical studies (Abebaw & Ayalneh, 2007; Tewodros & Fikadu, 2014).

Farmland size: Having more cultivable land was strongly associated with 11.4% of being food secure at less than 1% significance level. This could mean that households with more cultivable land could produce more food, may purchase food for consumption from the income they get

from their land, or even may diversify their crop to insure for crop failure. Hence, ways should be sought to lift-off the pressure on farmland size.

Access to irrigable land: A unit increase in access to irrigable land was associated with 9.3% probability of being food insecure with a 10% significance level. This could be partly due to the products which were produced by the farmers require the use of modern inputs which were expensive and not easily available. Besides, the meddling of brokers who compel rural households to sell their products with lower prices to those who also cheat them on the scale when measuring the products might contribute for the food insecurity. Thus, the manipulation of the brokers and the cost of modern inputs keep them into a debt spiral that results in food insecurity and even poverty.

Total annual income: The finding on the total annual income shows the existence of statistically strong evidence (at $p< 1\%$) that an increase in annual income will increase the probability of being food secure, but the corresponding percentage of increment was much lower than 1%. It could be learned that creating more income generating opportunities could be helpful by improving their purchasing power, let farmers use modern inputs that improve their production and productivity, and even make them rent in more farmland that could help them diversify their production activities.

Noticed frequent drought: It was obtained from the finding that, the more frequent drought occurs there is an 11.1% probability for households to become food insecure at 10% significance level. This is due to the fact that frequent drought could result in crop failure that impedes the availability of food and reduce income that households could have earned from their production.

Distance to input and output market: Distance to input and outputs markets was found to have strong negative influence on the food security situation of the households, i.e. a unit increase in distance from input and output markets increases the probability of being food insecure with 14%. This finding was statistically significant at 1% level. It implies that market centers should be expanded so that distance could be shortened and people will easily get inputs which help them improve their production and productivity. Besides, it could enable them sell their products to generate more income that will be used for consumption smoothing and diversify their income sources.

Distance to road transport: The finding again shows that for a unit increase in the distance from road transport, there was a 10.4% probability for the households to be less food secure with a statistical significance level of less than 10%. This could be because when distance to road transport increases people may not be encouraged to diversify and produce marketable products.

Distance to health facilities: The finding shows unexpected result that an increase in distance from health facilities is associated with 17.6% probability of increase in being food secure at *p*-value of less than 1%. Of course, this finding may require further verification since it is contrary to established facts in the area.

Availability of other supporting organizations: It was found that availability of supporting organizations could improve the food security status of households with a probability of 6%. This finding was statistically significant at less than 5% level. With a great care not to create dependency syndrome, introducing support by partner organizations could assist in smoothing consumption and even may enable households support themselves.

4.6 Conclusion and Recommendation

Food insecurity has been a serious problem troubling rural households with detrimental effects in Ethiopia. This problem is more worrisome now than ever before due to the unprecedented variability of the climate and the poverty trap that rural people are in. This paper aims to examine the food insecurity status, and identify their determinants for the rural households in Boset District, East Shewa zone. To unravel the situation and get a comprehensive understanding a suite of indicators was employed. The indicators employed are the ones which were widely applied and validated in different areas. The findings show that households which account 26.5%, 21.7%, and 41.3% were *highly* food insecure through MAHFP, HFIAS and HDDS, respectively. Similarly, the WASH results show 56.9% of the respondents did not have access to safe drinking water, 46.1% not owned latrines, and 64% disposed waste in unsafe way.

Results of determinants of the food security revealed educational status, farmland size, total annual income, distance to health services, and availability of supporting organizations were positively associated with being food secure. To the contrary, access to irrigable land, occurrence of frequent drought, distance to input and output markets, and distance from road transport were negatively associated with being food secure.

It can be observed that frequent occurrence of drought is found to have statistical signifcance in making households food insecure. Tis fnding is in line with what the climatic and environmental theories propose in explaining food insecurity. On the other hand, distance from inputs and outputs markets, and from road transport could show the governments' incompetence and lack of commitment in curbing food insecurity as was argued in the political economy explanation. Lastly, the inability to diversify households' income and the frequent drought occurrence could imply the applicability of the theory that contends food insecurity as an outcome of vulnerable livelihood. Our study suggests that due to the seasonal nature of food insecurity, future research may need to be conducted based on longitudinal data so that consistency of fndings could be confrmed and interventions could be made efcient. Besides, decision makers in the area should insist in the future about the use of multiple indicators to clearly understand the nature of the prevailing food insecurity and respond accordingly.

Chapter 5: Roles of Institutions in Curbing Food Insecurity in the Face of Climate Variability: The Case of Boset District, East Shewa

Abstract

Food insecurity has been a big challenge affecting millions of rural people in Ethiopia on yearly basis. A particular reference to Boset District showed that it was identified as one of the chronically food insecure districts**.** This paper aims to unravel the causes of food insecurity and examine the roles institutions play in tackling the problem. We employed various sources of data which include survey of 397 rural household heads selected via systematic sampling technique, Focus Group Discussions, Key Informant Interviews, and looked at pertinent secondary documents. The findings revealed that there were a multitude of causes of food insecurity, the principal of which include: frequent drought, diminishing landholding size, shortage of cash, lack of credit services, and lack of saving culture. The informal institutions were found to dwell on their customary services (like comforting families at times of mourning) and their overall roles were gradually diminishing. Likewise, the formal institutions have not improved their services and/or approach with the changing time which makes their services inadequate. Households were faced with severe shortage of cash and credit services; the Development Agents discriminate and serve a dual role of development and calming the community members; health extension workers were preoccupied only with family planning services; the local authorities complained the services of the NGO(s), rather than complementing each other. All these add up to make the roles of both formal and informal institutions in addressing the prevailing food insecurity to be perverted. Thus, our finding affirms and suggest viewing the causes of food insecurity as multiple which call for a multi-dimensional intervention; the need for reorientation and strengthening of the informal institutions; and creating a system of accountability for the formal institutions so that one can ensure the implementation of what was written on the documents to be provided for the wider society.

Keywords: Causes of food insecurity; Roles of Institutions; Boset; Rural Ethiopia

5.1 Introduction

The problem of food insecurity is a growing health and well-being concern of many individuals worldwide (Misselhorn, 2009; Barrett, 2010; Tam *et al.*, 2014**).** That is why Conceicao *et al.* (2016) illustrated that there still remain important pockets of food insecurity around the world, affecting hundreds of millions of people. Similarly, it was documented that an unacceptably large number of people still lack the food they need for an active and healthy life, in which about 795 million people in the world were undernourished in 2014–16 (FAO *et al.*, 2015). The same document showed the vast majority of those hungry live in the developing regions, where an estimated 780 million people were undernourished in 2014–16 (FAO *et al.*, 2015).

Chronic and acute food insecurity is prevalent, especially among rural populations and smallholder farmers in Ethiopia in which about 10% of citizens are chronically food insecure and this figure rises to more than 15% during frequent drought years (Birara *et al.*, 2015). Even in average rainfall years these households cannot meet their food needs and rely on food assistance (Conway & Schipper, 2011). In fact, it is agonizing that Ethiopia is still referred to as one of the most food insecure and poor countries in the world (Messay, 2009; van der Veen & Tagel, 2011; Abraham *et al.*, 2017; Malla *et al.*, 2017). In a similar vein, Gill (2010) described that "instead of its glorious past and rich culture, we now associate Ethiopia with famine, and it has become the iconic poor country" (p. 3). In conformity to what Gill reported, the recent Global Hunger Index (GHI) of 2017 showed Ethiopia to be located in the 'serious' category with a score of 32.3 and ranking 104th out of 119 countries considered for the computation (von Grebmer *et al.*, 2017).

According to Ellis (2003), there are many factors that can be implicated in making people less than food secure: seasonality, being food deficit from own production, and the abundance of risk factors. Taking the same notion, Birara and colleagues (2015) also affirmed the existence of multiple factors which contribute to trap Ethiopia in the current state of food insecurity and poverty. Likewise, in a Climate-Smart scoping study for Ethiopia, FAO (2016a) has identified erratic and unreliable rainfall and the failure of current agricultural techniques to mitigate such conditions; inefficient use by farmers of agricultural resources such as soil amendments; and rainwater; limited use of improved seed and fertilizers and inadequately resourced agricultural extension systems as factors that perpetuate food insecurity in the country.

Still there are many studies that identified multiple factors as causes of food insecurity in the Ethiopian context (e.g. Markos, 1997; Degefa, 2001; Degefa & Tesfaye, 2008; Messay, 2009; Conway & Schipper, 2011). It has been outlined that environmental crises and natural disasters, access to productive assets, socio-demographic factors, lack of diversification in economic activities, political inequalities, and violent conflicts are the causes for food insecurity (Baro & Deubel, 2006; van der Veen & Tagel, 2011; Meskerem & Degefa, 2015). In addition, Devereux and Edwards (2004) quoting IDS (2002) have explained that nowadays failures of national policies and global politics dominate thinking on famine and food insecurity. Indeed, it should be noted that the existence of such multiple causes of food insecurity can make the task of solving the prevailing problem a daunting undertaking.

Contrary to what is discussed in the preceding paragraphs, however, the incumbent authorities of Ethiopia were observed externalizing the causal factors to some natural disasters (see e.g. Lautze & Maxwell, 2007; Ali, 2008). Thereby, the role to be played by institutions is downplayed. Nonetheless, different empirical studies showed the truth is that disaster is just only part of the story. For example, Smith and Petley (2009) noted drought is only part of a 'complex emergency'. On top of this, Vadala (2009) showed the paradox that drought of the same intensity resulting in famine in many sub-Saharan countries, including Ethiopia, whereas it is not the case in other countries. It was demonstrated that "… in recent years that nature's forces and climatic conditions like drought cannot solely be responsible for famine causation as was the dominant mode of thinking five decades ago. There is more to famine than just drought or other adverse climatic conditions" (Vadala, 2009, p. 1071).

According to Mesfin (1986, p. 177), externalizing the factors that generate food insecurity should be rejected on two grounds. First, such conceptions and explanations of food insecurity could cloud our understanding of the problem. Second, by removing the issues out of context of food insecurity these views tend to delay resolute action by exaggerating external forces and underestimating the responsibility of internal socio-economic and political forces. Of course, the reasons why some regimes externalize the causal factors of food insecurity could vary. Among the possible reasons one could be to amass resources that are channeled from abroad in the name of the affected population (Cohen & Werker, 2008). The second possible reason why regimes

externalize the causal factors could be just to minimize their accountability, which could serve as a cover-up of their inability.

With this backdrop, when one looks for a solution to the lingering problems of food insecurity, the roles played by institutions are something that beg greater attention. Institutions are considered as the kinds of structures that matter most in the social realm which make up the stuff of social life (Hodgson, 2006). Similarly, Scoones (1998) contended that understanding institutional processes allows the identification of barriers and opportunities (or 'gateways') to sustainable livelihoods. Liu and colleagues (2017) on their part stated that under the joint efforts of formal and informal institutions, people may gain better access to assets and generate more desirable livelihood outcomes. Besides, Muller *et al.* (2017) have argued that institutions should be seen as an 'enabling' mechanism which provides rights and benefit systems, powers and responsibilities and choice sets. To be more specific, Morton *et al.* (2008) as cited in Dean and Sharkey (2011) have identified two forms of economy that may ameliorate food insecurity: reciprocal economies—receiving support from family or friends—and distributional economies or institutional support.

Nonetheless, before delving into the details of how institutions help in achieving food security or constrain the achievement, it is better to know how institutions are conceptualized. According to Hodgson (2006), though the use of the term 'institution' dates back to 1725, there is no unanimity in the definition of this concept. Likewise, Scoones (1998) has shown that institutions are often fluid and ambiguous, and usually subject to multiple interpretations by different actors. But for the sake of convenience institutions are conceptualized in this paper as the rules of the game in a society (North, 1990).

A review of the literature shows that institutions are commonly categorized into formal and informal (North, 1990; Scoones, 1998; Lovendal & Knowles, 2006; Osei-Tutu *et al.*, 2015). Given these two categorizations, formal institutions are closely related to the corridors of state, its agencies, officials and state-sanctioned activities (Boussard, 2000; Tsai, 2002; cited in Muller *et al.*, 2017). It was again elaborated that formal institutions can be characterized by the federal constitutions, statutes, laws, directives and local government laws, and the activities, procedures and operations sanctioned by state agencies and officials, and established rights at international, national and sub-national levels (North, 1990; Muller *et al.*, 2017). In addition, Hodgson (2006)

indicated that "organizations are special institutions that involve (a) criteria to establish their boundaries and to distinguish their members from nonmembers, (b) principles of sovereignty concerning who is in charge, and (c) chains of command delineating responsibilities within the organization" (p. 8).

Informal institutions, on the other hand, may elicit more than one meaning depending on the context (Muller *et al*., 2017). To this end, Muller *et al.* (2017) described that the conceptualization of informal institutions hinges on some indicators which include, inter alia, social and cultural beliefs and norms which are mostly not codified. For Casson *et al.* (2010), in the developing countries context, informal institutions emerge as the preponderant rules of interaction when formal institutions and markets fail. To complement this argument, it is possible to look into the point forwarded by Hu (2007) who stated that trust is the most important factor in the informal institutional system where the formal monitoring and enforcement frameworks are absent in the system.

Futhermore, it can be observed that informal institutions and social capital appear to have an overlapping meaning. Social capital attempts to capture the social claims on which households can draw by virtue of their belonging to social groups of varying degrees of inclusiveness in society at large (Ellis, 2000). Similarly, Moser (1998) explains social capital as the reciprocity within communities and between households based on trust deriving from social ties. Taking the notion of reciprocity, Ellis (2000) also expounds that social capital "… directs attention to personal or family networks, typically comprising near and remote kin, as well as close friends, that offer spatially diverse potential means of support when past favors are reclaimed" (p. 36).

Institutions, in general, do have various roles to play within a given society. For instance, Agarwal (2010) discussed that institutions serve as information gathering and dissemination, resource mobilization and allocation, skills development and capacity building, leadership, and means of connecting with other decision-makers and institutions. Likewise, Degafa **(**2009) explained that institutions assist to transfer assets and resources to people with poor wellbeing from either relatively well-off counterpart members, from government or NGOs.

When one closely looks at the contributions of institutions in averting problems of food insecurity it is possible to see the roles of different government progams as part of the formal institutions like PSNP, on the one hand; and roles of social capital, as part of the informal

institutions, on the other hand. With regards to the latter roles, different empirical studies have obtained a positive association between a strong social network and food security in Puerto Rico (Dhokarh *et al.*, 2011); social capital was again found to be positively associated with food security in Malawi which is expressed in terms of membership to farmers' organizations, total number of voluntary groups and the size of social network (Dzanja *et al.*, 2015). In a more pronounced way, Dzanja *et al.* (2015) stressed that "it is not uncommon for people to receive help in cash and kind from neighbours and relatives in times of social or economic crises and this is a reflection of social capital at work" (p. 174).

Thus, when it comes to the justification for conducting this study, it is possible to start with the repurcussions of food insecurity. First, Asa and Archibong (2016) have succinctly summarized the consequences of food insecurity and underscore that it creates grievous socio-economic and political consequences by stagnating economic growth and resulting in political instability 'as a hungry man is known to be an angry man'. Second, the preoccupation of authorities that food insecurity is 'mainly' caused by shocks (like drought) could lead to a wrong prescription and misuse of resources. Thirdly, it was illuminated that little is known about the role that institutions play in enabling the poor to accumulate assets, protect them from shocks, and transmit these assets to future generations (IFPRI, 2011); and, the difficulty to thoroughly understand rural livelihoods and food security situations without having insights into some of the local institutions and related rituals (Degefa, 2009). Besides, even at regional levels it is said that "the linkage between social capital and food security has not been extensively studied in the Sub-Saharan Region, although the region faces food security challenges" (Dzanja *et al.*, 2015, p.167).

Generally, despite the Ethiopian government's earnest efforts to develop the agricultural sector (Messay, 2012), food insecurity and the concomitant problems have remained the greatest challenges of the rural population in general and the study area in particular. Hence, this study aims to uncover the causes of food insecurity and examine the roles of both formal and informal institutions in curbing the problem in the study area. In doing so multiple data sources which comprise primary and secondary were utilized to obtain the required data. The study could complement on the limited literature on roles of institutions, help in effective allocation of

resources in tackling food insecurity, and unearth the strength and shortcomings of the institutions for decision-makers.

5.2 Review of Some Policy Documents

Taking into account that formal institutions encompass the existing policies and programs (as was conceptualized by North, 1990 and Muller *et al.*, 2017), a closer look at few policy documents of Ethiopia is made in this section. In fact, there are so many documents produced by the current regime (i.e. EPRDF) to guide the development efforts of Ethiopia and thereby improve the livelihood of the population in general. Yet it is only few of the documents which have direct bearing on food (*in*)security that are reviewed to help us understand what is going on the ground and scrutinize the roles of those formal institutions.

To start with, the constitution of Ethiopia is said to be one of only 20 constitutions in the world which make reference to food (Vadala, 2009) in which in Article 90 of the Constitution it is stipulated that all Ethiopians shall be provided with food, among others.

It was clearly indicated in the 2002 food security strategy document that the strategy adopted rests on three basic pillars: to increase the availability of food through increased domestic production; to ensure access to food for food deficit households; and to strengthen emergency response capabilities (MoARD, 2002, p. 7). This strategy aims to realize through provision of rural credit, markets, infrastructure and improving farmers' skill. Furthermore, it was stipulated that livestock, water harvesting and management, and agro-forestry would be the central elements of food security activities in moisture deficit and pastoral areas. Similarly, off-farm income generating activities, capacity building, agricultural research to generate technology, agricultural marketing and credit as well as infrastructures are critical cross-cutting aspects of the food security strategy. In the document it is also indicated that development of irrigation is integral to the pursuit of food security in order to reduce dependency on rain-fed agricultural conditions and thereby increase the opportunities for year round agricultural production.

In the 2002 food security strategy document it is also stated that measures will be taken to strengthen and expand rural micro-finance institutions and to broaden services to include banking services to rural communities to encourage rural savings and investments in farming and non-farming activities.

Under the Plan for Accelerated and Sustained Development to End Poverty (PASDEP) there was a Food Security Program (FSP) which was designed to address problems of shortfalls in food production, vulnerability to falls in consumption and incomes and consequent hunger that the country has faced repeatedly, through adaptation of development alternatives to bring about lasting solution (MoFED, 2006). In the same document it was indicated that the effort to reduce vulnerability is central to the five years plan strategy (2005/06-2009/10), and the measures include: more irrigation and water control, diversification of crops, and better integration of markets, transport, and information links; maintenance of macroeconomic stability; expansion of off-farm employment and income-earning opportunities, and better functioning credit markets; provision of improved health services and nutrition; introduction of innovative measures, such as experiments with crop and weather-based insurance mechanisms; and, above all implementation of the national FSP designed to manage the shift away from the cycle of dependence on emergency relief.

In the Growth and Tansfomation Plan (GTP I) Ethiopia has envisioned in the long-term "to become a country where democratic rule, good-governance and social justice reigns, upon the involvement and free will of its peoples; and once extricating itself from poverty and becomes a middle-income economy" (MoFED, 2010, p. 7). In order to attain this vision there were seven pillars set to be realized. One among these pillars is 'maintaining agriculture as a major source of economic growth'. It was stated that the agricultural strategy will direct on placing major effort to support the intensification of marketable farm products - both for domestic and export markets, and by small and large farmers. Fundamentals of the strategy include the shift to produce high value crops, a special focus on high-potential areas, facilitating the commercialization of agriculture, supporting the development of large-scale commercial agriculture where it is feasible. The commercialization of smallholder farming will continue to be the major source of agricultural growth. To complement this concerted support will be given to increase private investment in large commercial farms. A range of public investments will also be continued to scale-up the successes registered in the past. Transparent and efficient agricultural marketing system will be strengthened. Investment in marketing infrastructure will also be increased (MoFED, 2010, p. 8).

In what follows, the Second Growth and Transformation Plan (GTP II) is built on sectoral policies, strategies and programs, lessons drawn from the implementation of GTP I and the post-2015 sustainable development goals (National Planning Commission [NPC], 2016). In this plan document the pillars on which the plan document focuses have grown to nine. In the GTP II it was indicated that the technical efficiency and technological progress of the economy is believed to be at a low level. To reach the production possibility frontier of the economy from this low level, enhancing efficient allocation and utilization of resources with a sense of urgency is crucial. It was stated that different sub-sectors within agriculture and manufacturing industry (main productive sectors) will be given utmost emphasis in this regard. In this document, it was highlighted that enhancing the productivity of smallholder farms (the main source of growth in the sector) will be given priority (NPC, 2016). The plan document revealed that the competitiveness, quality and productivity enhancement schemes in the agricultural sector will be facilitated through proper development and dissemination of available technologies; implementing extension system according to the direction stated; that is, the scaling up of best practices of model smallholder farmers with in the developmental army framework; and tackling the challenges which constrained the achievement of potential production capacity, and improving the efficiency of the sector. Moreover, for farmers operating along the existing production possibility frontier, new appropriate technologies and farming practices will be delivered in order to bring about technological progress.

Furthermore, another document that is assessed is "Ethiopia's Climate Resilient Green Economy". The document has stated that Ethiopia will ensure that growth creates a carbon neutral *'green economy'.* It is mentioned that this is for four distinct reasons. The first is to contribute towards the global mitigation of greenhouse gases (GHG) to avoid dangerous climate change. The second is to avoid over-exploitation of natural resources such as forests and croplands and ensure their long-run economic contribution. The third is to reduce the fiscal burden from importing fossil fuels (which already amounts to 4% of GDP), and the fourth is to ensure inclusive benefits of growth, especially to improve the resilience of poorer communities that are most vulnerable to the impacts of climate change (MoFED, 2011).

Hence, it should be noted that, in the following section findings on the ground are assessed against what is indicated in the documents reviewed in the preceding paragraphs.

5.3 Materials and Methods

5.3.1 Description of the study area

Boset district extends between $8^0$24'- $8^0$51' North latitude and $39^0$16'- $39^0$50' East longitude. It is located in the northeast part of East Shewa zone, Oromia National Regional State. It is bordered with Adama district in the west; by Amhara National Regional State in the north; by Fantale district in north-east and by Arsi zone in south-east. Based on the results of National Population and Housing Census of Ethiopia conducted in May 2007, a population projection was made for all Regions and Districts from 2014 – 2017. Accordingly, data obtained from Central Statistical Agency [CSA] (2013) indicated that the total population of Boset district for the year 2017 was projected to be 189,795 out of which 42,793 (22.5%) are urban population and 147,002 (77.5%) are rural population.

Based on a report obtained from the district's Finance and Economic Development Office (2012), Boset district is located in the midst of the Rift Valley, which extends from the North to South. Climatically most parts of the district (about 89%) belong to tropical (*kolla*) agro-climatic zone and the remaining small section (about 11%) is sub-tropical (*woina dega*). The district is characterized by hot and dry weather with an average annual temperature which varies between 25 – 30^0C for the tropical (*kolla*) and 15 – 20^0C for the sub-tropical (*woina dega*). The rainfall is weakly bi-modal with spring (a small rainy season) during the months of April and May while summer (a long rainy season) during the months of July - September. The average annual rainfall ranges between 700 – 800 mm with the intensity and variability being high in the district. In terms of drainage system the district falls in the Awash River Basin, with no other major streams and lakes. As a result, there was acute water problem for livestock and people.

5.3.2 Research design, sampling, and data analysis

This study was conducted in Boset District, East Shewa zone of Oromia National Regional State. It was undertaken as a cross-sectional survey using mixed methods research approach. The choice of mixed methods was dictated by the research problem under investigation and to benefit from the merits of using this research approach (as justified by Johnson & Onwuegbuzie, 2004; Creswell, 2009, 2012; Creswell & Clark, 2011).

In terms of sources of data, both primary and secondary sources were utilized. The primary data were generated by employing household survey which was administered by 12 Development Agents (DAs) who are familiar to the study area and conversant with the local language (Afan Oromo). After pretesting and fully developing the structured questionnaire, it was administered face-to-face. Key informant interviews (KIIs) were also held with heads of offices and focal persons from health, women's and children's affairs, water resources, irrigation, crop production, livestock production, natural resources management, disaster preparedness and prevention, World Vision Ethiopia (Boset Area Development Program), and community elders living in the sample *kebeles*.

Similarly, focus group discussions (FGDs) with selected 6 men's and 4 women's groups were conducted separately with members comprising 6-10 individuals. The groups were formed on volunteer basis with the help of the DAs working in the respective sample *kebeles*. The criteria for inclusion in the group discussion were household heads lived in the *kebele* for more than 5 years and some knowledge on food insecurity issues. Lastly, personal observations coupled with informal discussions were also employed to generate primary qualitative data. On the other hand, we have utilized current and relevant journal articles which were mainly published within the last ten years as sources of secondary information.

To have a full picture of the district, a total of 6 *kebeles* located at different places were selected purposely by the district level experts after thorough discussion on the topic of the research. Besides, food insecurity status, access to irrigation facilities, and participation in the Productive Safety Net Program (PSNP) were also used as criteria for selecting the *kebeles*. The PSNP was used as one criterion to get those *kebeles* which are chronically food insecure, this is because it is only 10 *kebeles* of the district under the PSNP. Otherwise, it was not the intension of this study to assess the impacts of PSNP.

List of households living in each of the selected *kebeles* was taken as a sampling frame, then respondents were selected using systematic random sampling technique proportionate to the size of households living in each *kebele*. The systematic random sampling technique was employed because it is one of the probability sampling methods and is easy to manipulate during selection of the sample households (Babbie, 2008; Bryman, 2012). Using the formula developed by Yamane (1967) as cited in Israel (2013), the sample size was calculated which resulted in a total

of 397 participants (48 female- and 349 male-headed households). In the determination of the sample size, a 95% confidence level and a *p*-value of .05 for maximum variability were assumed.

Mathematically, the formula is presented as:

$$\mathrm{n} = \frac{N}{1 + N(e)^2}$$

where *n* stands for the sample size, *N* signifies the total number of households in all the *kebeles*, *e* designates maximum variability which is 5% (0.05), and 1 stands for the probability of the event occurring.

Based on the nature of the variables measured, to analyze the data collected both descriptive statistics and thematic analyses were employed. Accordingly, in identifying the causes of food insecurity descriptive statistics coupled with chi-squared test was employed. Besides, results of FGDs, KIIs, and the field observations were transcribed and analyzed according to themes (based on the categorization of the causes of food insecurity already formed, and the roles of informal and formal institutions observed). With respect to roles of formal institutions documents analysis was also undertaken. Finally, findings of the descriptive statistics are presented using tables, figures, and charts.

5.4 Results and Discussion

5.4.1 The multiple causes of food insecurity

Based on review of the literature and recommendation by an expert, the causes of food insecurity are broadly classified into five categories, thus the analysis of findings was made accordingly. It was thought that the appropriate identification of the causes of food insecurity would be helpful for effective allocation of resources so as to alleviate the problem.

The first causes of food insecurity identified were those related to environmental factors in which the findings are presented in Table 5.1.

Table 5.1 Environmental causes of food insecurity (Multiple responses)

Environmental reasons	Buta Wagare		D/Wanga		Q/H/ Mirqasa		Sara Areda		Sifa Batte		Tiri Birreti		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Drought	9	42.9	8	26.7	141	88.1	41	78.8	98	90.7	14	53.8	311	78.3
Erratic rain	20	95.2	20	66.7	81	50.6	39	75.0	97	89.8	19	73.1	276	69.5
Poor soil fertility	5	23.8	2	6.7	30	18.7	21	40.4	36	33.3	1	3.8	95	23.9
Weeds	10	47.6	19	63.3	2	1.2	0	0.0	7	6.5	3	11.5	41	10.3
Soil erosion	10	47.6	2	6.7	2	1.2	5	9.6	9	8.3	1	3.8	29	7.3
Diseases and pests	2	9.5	1	3.3	2	1.2	7	13.5	8	7.4	1	3.8	21	5.3
Total	56	266.7	52	173.3	258	161.2	113	217.3	255	236.1	39	150.0	773	194.7

Overall Test(s) of Significance: Pearson chi2 (140) = 641.6691 Pr = 0.000

Table 5.1 shows, from the six environmental causes of food insecurity, drought takes the largest share (78.3%) followed by erratic rain, which accounts 69.5%. A Comparison between the sample *kebeles* also reveals that drought is the highest cause of food insecurity for *Sifa Batte*, *Q/H/Mirqasa*, and *Sara Areda kebeles*, respectively. With respect to erratic rain, 95.2% of respondents from *Buta Wagare* and 89.8% of respondents from *Sifa Bate kebeles* mentioned it as the top environmental cause of food insecurity. Statistically, the Pearson chi2 test of significance shows there is significant difference among the environmental causes of food insecurity across the sample *kebeles* at less than 1% significance level. This could imply that interventions would be more effective if actions are taken according to the severity of each cause. In addition, as frequent drought and erratic rain are the manifestations of climate variability and change, it can be deducted that the rural households are already being affected by the vagaries of climate variability that could result in food insecurity.

In a study conducted to look the seasonality of food insecurity by Degefa (2001), similar finding was obtained that the overwhelming majority of respondents in his study area have faced drought and erratic rain as the major environmental reasons for food insecurity. As to the implications, different studies show that a more frequent drought and an erratic rain could pose a significant threat to livelihood and food security, and even overall development efforts' of a nation (van der Veen & Tagel, 2011; Mutabazi *et al.*, 2015; Menberu, 2016). Moreover, Molau (2002) has also emphasized that the ability of farmers and rural households to grow enough to feed themselves could be hampered to a large extent.

Furthermore, the environmental reasons not only have an immediate negative impact, but also in the long run lead to underinvestment, agricultural stagnation and rural poverty (Devereux, 2007). This argument is also complemented by Molua (2002) who stated that "as the environment becomes riskier, low income and vulnerable households shift production to more conservative but less profitable modes" (p. 537). Additionally, scholars have also described that the environmental factors could lead to asset lose that jeopardize households' security, undermine farm yields, reducing household food availability, and agricultural income derived from crop sales that will end up into food insecurity (Devereux, 2007; Thabane *et al.*, 2014).

The second category for the causes of food insecurity is that which emanates from demographic factors. Findings of Table 5.2 show diminishing landholding size (79.3%) and farmland fragmentation (59.9%) were the two most frequently identified demographic reasons.

Table 5.2 Demographic reasons of food insecurity (Multiple responses)

Demographic reasons	Buta Wagare		D/Wanga		Q/H/ Mirqasa		Sara Areda		Sifa Batte		Tiri Birreti		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Diminishing land holding size	19	90.5	27	90.0	104	65.0	50	96.1	101	93.5	14	53.8	315	79.3
Farmland fragmentation	7	33.3	17	56.7	79	49.4	39	75.0	82	75.9	14	53.8	238	59.9
Lack of fallow land	5	23.8	0	0.0	51	31.9	6	11.5	45	41.7	3	11.5	110	27.7
Overgrazing	6	28.6	3	10.0	23	14.4	17	32.7	21	19.4	7	26.9	77	19.4
Total	37	176.2	47	156.7	257	160.6	112	215.4	249	230.6	38	146.1	740	186.4

Overall Test(s) of Significance: Pearson chi2 (65) = 240.7716 Pr = 0.000

Similar to what is found in the survey, the process owner of the natural resources management office of the district has expressed that the ever increasing population is really contributing to food insecurity in the district. He explained that:

Due to shortage of farm land, the high demand for firewood and the prevailing poverty within the society, rural households are engaged in clearing of forest cover in their locality which lead to severe soil erosion, nutrient lose and decline of productivity, and finally result in food insecurity. Besides, a cycle of food insecurity and poverty are observed in the district due to the unsustainable use of resources in the attempt to fill the food gap created. To avert this situation, there is a yearly program of tree planting, though there was no follow up once trees were planted.

As far as the consequences of diminishing landholding size is concerned, based on the finding from his study in the northern Ethiopia, Markos (1997) has argued that as landholding is the fundamental basis of the livelihood of the rural people, its scarcity tells perpetuity of food insecurity under the current technology of production. This could be further justified by the fact that low levels of household incomes will be the inevitable outcomes of diminishing land sizes. The demographic factors highlighted in Table 5.2 were not only affecting the per capita food availability but also were severely constraining livestock rearing in the locality. For instance, one key informant has informed that the rural households were seriously destocking the livestock they owned due to lack of grazing land. This could imply how much the households could be denied of the direct benefits they get (by consuming the animal products) and indirectly through lose of the income they could have made by selling the products.

As far as land fragmentation is concerned, Messay (2009) posited three lines of arguments in which fragmentation of farmlands plays against production activities: first, it results in long distance travel from one plot to the other and consumes more time that could be used to perform other farming activities; second, it creates a problem of transporting agricultural inputs and products (i.e. grain loss); and thirdly, those farmers who owned more number of plots may face problems in protecting the crops against wild animals which again results in pre-harvest grain loss. Owing to the fact that land fragmentation was the second top demographic reason for food insecurity one can imagine the extent of the problem when comparing the fact against the argument made by Messay.

Having carefully observed the implications of the demographic factors when dealing with food insecurity in the Ethiopian context, Vadala (2009) has cautioned that it will be imprudent to ignore the problem of decreasing land-size holdings for agricultural purposes in the country not least because around 85 percent of the population is engaged in subsistence agriculture. The author goes further even contending that “until people shift from agriculture to other sectors of the economy for their livelihood, the population pressure on agricultural land can be part of the explanation of famine in Ethiopia” (Vadala, 2009, p. 1073).

Food insecurity could also occur due to some economic reasons (the third category). Based on what the economic reasons constitute, the finding of the study which is presented in Table 5.3 shows that lack of cash (70.0%), absence of off-farm income (57.9%), use of traditional farm

implements (47.4%), and low modern inputs use (35.8%), contribute significantly for the food insecurity of the study area.

Table 5.3 Economic reasons of food insecurity (Multiple responses)

Economic reasons	Buta Wagare		D/Wanga		Q/H/ Mirqasa		Sara Areda		Sifa Batte		Tiri Birreti		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Shortage of cash	19	90.5	20	66.7	73	45.6	50	96.1	94	87.0	22	84.6	278	70.0
Absence of off-farm income	19	90.5	12	40.0	84	52.5	33	63.5	76	70.4	6	23.1	230	57.9
Traditional farming implements and practices	8	38.1	13	43.3	62	38.7	37	71.1	58	53.7	10	38.5	188	47.4
Low modern farm inputs	2	9.5	9	30.0	57	35.6	12	23.1	56	51.8	6	23.1	142	35.8
Shortage of farm oxen	1	4.8	9	30.0	3	1.9	7	13.5	9	8.3	6	23.1	35	8.8
Total	49	233.3	63	201.0	279	174.4	139	267.3	293	271.3	50	192.3	873	219.9

Overall Test(s) of Significance: Pearson chi2 (125) = 431.1570 Pr = 0.000

It can be derived from Table 5.3 that just lack of cash (the number one constraint) could lead to the occurrence of the succeeding constraints, i.e. households who lack cash may not be able to diversify their income, not be able to use modern technologies, and deter from the use of modern farm inputs. Thereby, it could be difficult to expect the households ensure their food security given such shortcomings which are all crucial and interrelated.

Comparison with other studies also show that lack of cash and absence of off- farm income were among the top claimed economic reasons for food insecurity (Degefa, 2001). In addition, Spielman *et al.* (2011) have affirmed from official estimates of the Central Statistics Agency (CSA) of Ethiopia that farmer use of improved seed covered an average of only 4.7 percent of cropped area in 2007–08.

Findings from Table 5.3 which show traditional farming implements and practices (47.4%), and low modern inputs use (35.8%) together could constrain significantly the attainment of food security. A closer look at this finding could indicate a direct contrast with what is stated in the Growth and Transformation Plan (GTP) I document. The document highlighted that, to enhance the smallholders' agriculture growth, among other things, a system will be created for rapid

transfer of practically tested technologies, continuously testing new technologies and supplying them to farmers (MoFED, 2010). The same document further goes on stating "in the coming five years the required fertilizer, improved seeds, and small farm machineries will be made available with the requisite quality and quantity" (MoFED, 2010, p. 22). An appraisal of the finding in this study against the statements made in the GTP I show the existence of a fault line that requires a serious reconsideration of the approach adopted by the government.

As far as use of technologies is concerned, Brown (2016) has stressed that new technologies and interventions are needed to increase overall food production and at the same time improve farmers' resilience to extreme events. Thus, it should be noted that as the environment in the study area has undergone so many changes, using traditional farm implements will not be helpful in meeting the increasing demand for food.

The other categories of reasons that caused food insecurity in the study area were physical factors. Findings from Table 5.4 show that lack of credit (51.4%), lack of irrigation facilities (48.6%), and lack of agricultural extension services (32.5%) were the top three constraints. It can also be observed that there is a statistically significant difference among the physical reasons of food insecurity across the sample *kebeles*.

Table 5.4 Physical reasons of food insecurity (Multiple responses)

Physical reasons	Buta Wagare		D/Wanga		Q/H/ Mirqasa		Sara Areda		Sifa Batte		Tiri Birreti		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Lack of credit	7	33.3	11	36.7	94	58.7	25	48.1	57	52.8	10	38.5	204	51.4
Lack of irrigation access	20	95.2	25	83.3	7	4.4	40	76.9	84	77.8	17	65.4	193	48.6
Lack of extension services	0	0.0	1	3.3	63	39.4	20	38.5	35	32.4	10	38.5	129	32.5
Use of traditional storage facilities	4	19.0	1	3.3	30	18.7	25	48.1	22	20.4	5	19.2	87	21.9
Lack of road transport	13	61.9	0	0.0	22	13.7	4	7.7	32	29.6	0	0.0	71	17.9
Total	44	209.5	38	126.7	216	135.0	114	219.2	230	213.0	42	161.5	684	172.3

Overall Test(s) of Significance: Pearson chi2 (145) = 509.9563 Pr = 0.000

Similar to what is found in this study, Mutabazi and colleagues (2015) have also found in the African context that credit is a vital missing part which could have helped in using modern inputs, livestock integration or enterprise diversification. As to the consequence, it was argued

that lack of credit undeniably impedes employment generation, savings mobilization, investment, and consumption smoothing of the rural poor in particular (Bidisha *et al.*, 2017).

Lack of irrigation access is the other physical reason that deserves special mention and discussion. From Table 5.4 it can be observed that except respondents of *Qawa Hara Mirqasa kebele*, the rest of the respondents have prioritized this constraint. This could be because of two reasons. The first one was due to the fact that drought is so frequent that people were faced with shortage of water. Second, even though Awash River is crossing through their *kebeles* majority of the respondents were confronted with shortage of water and food insecurity due to lack of money and technical capacity. With regards to the second reason, so many focus group discussants also strongly complain the local authorities for failing to avail the facilities. However, an interview made with head of the Irrigation Agency of the district revealed that due to topography of the land in the district and concern for downstream users, it is difficult to increase the irrigation service beyond the current level. The response from the head of the Irrigation Agency may show how institutions could constrain the availability of resources that could have helped in alleviating food insecurity of the rural households.

In the GTP I document it was mentioned that to better cope with climate variability and ensure food security 'expansion of small scale irrigation will be given priority' (MoFED, 2010). However, in the study area survey respondents and participants of the discussions revealed it was difficult to utilize the river that crosses their district for irrigation. This finding again shows a divergence of what was written in the development document with the reality on the ground.

The final categories of the reasons for food insecurity are the social reasons. Among the social reasons lack of saving culture was one of the prime social causes of food insecurity (Table 5.5). In contrast, sickness of household members was the least identified cause of food insecurity. However, the Pearson chi2 test shows the existence of a statistically significant difference among the sample *kebeles* with respect to social reasons of food insecurity (at $p< 1\%$).

Table 5.5 Social reasons of food insecurity (Multiple responses)

Social reasons	Buta Wagare		D/Wanga		Q/H/ Mirqasa		Sara Areda		Sifa Batte		Tiri Birreti		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Lack of saving culture	10	47.6	16	53.3	119	74.4	44	84.6	81	75.0	19	73.1	289	72.8
Lack of education	10	47.6	8	26.7	87	54.4	47	90.4	77	71.3	21	80.8	250	63.0
Lack of food aid	8	38.1	6	20.0	44	27.5	18	34.6	45	41.7	3	11.5	124	31.2
Lack of human labor	5	23.8	19	63.3	21	13.1	9	17.3	28	25.9	6	23.1	88	22.2
Sickness of household members	0	0.0	0	0.0	0	0.0	2	3.8	2	1.8	1	3.8	5	1.3
Total	33	157.1	49	163.3	271	169.4	120	230.8	233	215.7	50	192.3	756	190.4

Overall Test(s) of Significance: Pearson chi2 (100) = 291.2121 Pr = 0.000

Key informants and focus group discussants have also mentioned that lack of saving culture is the most prevalent problem pushing households into food insecure status on yearly basis. When expessing the extent of this problem, the DAs mentioned that there were heads of households who even rent houses in the nearby town just to enjoy (excessively spend on alcohol drinks and eating meat) during the harvest time. The DAs added, most of the rural households purchase household utencils, clothes for family members, and held festivals immedietly after the harvest time. One thing that should be noted here is that households become extravagant at the time of harvest and sold back most of the items they purchased with cheaper price at the lean time.

In fact Gebrehiwot, Assefa, and Habteselassie (2011) have also found that saving is not a common practice among different community members in Ethiopia because of the deep rooted poverty and low standard of living. From their study Gebrehiwot *et al.* (2011) have concluded that there is generally poor saving cuture in Ethiopia.

Another important social reason that was observed during the study time and attested by the DAs was poor working culture. It seems that less attention was given to it both by the people themselves and the local authorities. The DAs working in the different *kebeles* explained that there are only few farmers in the respective *kebeles* who are determined to get out of their poverty situation. The DAs added that majority of the farmers are rather complacent and fatalistic. Similarly, even head of the district disaster preparedness and prevention office expressed his concern that so many of the residents in the district did not have good working culture. He emphasized that the rural households even hire labor from outside their family

though the burden was not beyond their capacity. In related view, Messay (2009) has also found inefficient working habit in his study and commented as a concern that needs to be emphasized.

5.4.2 The roles of informal institutions

The food insecurity situation of any area could be determined by the existing institutions operating in that specific area. One among such institutions is the informal one which could help mobilize resources at times of hardship or even constrain access to resources. Scholars now agree that informal institutions could be helpful through enhancing the production systems and permit farmers to withstand, recover from, and reorganize in response to crises linked with climatic risks.

It is noted by scholars and big organizations that gender equality can make a substantial contribution to a country's economic growth, and it is the single most important determinant of food security (Abu-Ghaida & Klasen, 2004; World Bank, 2012; cited in Asian Development Bank, 2013). In other words, it was argued that there is a close correlation between higher levels of gender inequality and food insecurity, malnutrition and other nutrition deficiencies (FAO, 2012; cited in IDS, 2014). With recognition of this fact, households were inquired their thought and experience on whether there exist equal rights between women and men in getting access to resources like land. Accordingly, among the total households that account about 71.5% (n=284) responded positively that women have equal rights on access to important resources, whereas the remaining 28.5% (n=113) stated they did not think women have equal rights with men.

During an informal discussion with residents in the study area it was found that the rising equality of rights between women and men could be attributed to the recent land certification provided (though not implemented on full scale) and the repeated effort made by the district Women and Children's Affairs office to create awareness on equality of women in all aspects. But it should be noted that women will have only use right of the resources (especially land) as long as they have children and are residing with their in-laws.

As far as the constraints for not having equal rights are concerned, those respondents who think women did not have equal rights with men in accessing land and other resources identified lack of awareness on equality of women (79.6%) and existence of some traditions (70.8%) which still

consider women as not equal with their male counterparts were the most frequently raised reasons for women lacking equality.

It can be learned that despite the local authorities' efforts to ensure equality of women, the existence of these constraints show still a lot is expected to be done. This finding could also imply that women could be in a disadvantageous position to ensure their food security because of the lack of equality to access resources that could have helped to this end.

Membership in different social organizations established by the community are one of the informal institutions employed for various purposes. On this issue, Dzanja *et al.* (2015) have argued that group membership extends the social networks of individuals and this allows for information and resource sharing which eventually improves economic welfare. Taking the diverse roles of social organizations into consideration, households have identified the social organizations in their locality (Table 5.6).

Table 5.6 Membership in social organizations (Multiple responses)

Types of social organizations	Response		Percent of Cases
	n	Percent	
Idir	383	47.1	97.2
Jigi/Dabo/Wanfal	287	35.3	72.8
Producers' association	55	6.8	14.0
Iqub	48	5.9	12.2
Mahiber	40	4.9	10.1
Total	813	100.0	206.3

Findings from Table 5.6 show the overwhelming majority of the respondents were members of *Idir* (97.2%) which is followed by *Jigi/Dabo/Wanfal*. As far as *Idir* is concerned, discussants told that it was mainly meant to contribute labor and food when someone is deceased. In the study area anyone who gets married was highly expected to join this institution as soon as they established a family. As far as roles of *Idir* are concerned, members are expected to comfort families of the deceased person. It was learned that membership in *Idir* serves as funeral insurance where community members contribute resources either in kind or in cash and support the mourning member. Our finding corroborates with the study conducted by Ephrem (2010) who also found the existence of some *Idirs* which prefer to stick with the "customary" role due to capacity constraints and members' demand. However, it should be noted that had this social organization transformed the traditional roles into development oriented, members could have

benefited a lot to be food secure. This is said because some *Idirs* have transformed their roles and are serving as engine for local development (see e.g. Ephrem, 2010).

The second most frequently mentioned informal institution is *Jigi/Dabo/Wanfal*, though these three are a bit different they were all meant to mobilize labor at times of sowing, weeding, and harvest. This is because during those times the labour demand is high which will be beyond the capacity of a given family. As farming activities are time sensitive, these informal institutions could play a greater role in timely accomplishment of tasks which will have a real impact on the outputs of households. Focus group discussants in the different sample *kebeles* told such arrangements are nowadays organized at a minimum level and only in critical conditions because of the increasing poverty situation in the communities that creates difficulty in preparing feasts for the individuals engaged in the work. Besides, discussants explained that the significance of *Jigi* and *Dabo* has declined because those who can afford resorted to hire daily laborers.

Producers' associations are known to serve different purposes for smallholder farmers. Among those purposes some include: identifying market opportunities, accessing markets, negotiating collectively with market intermediaries, accessing production technologies and information, and ultimately, sourcing inputs more cheaply, selling produce at a higher price, and increasing their incomes. As can be seen from Table 5.6, the numbers of households engaged in the producers' associations are very few. An informal discussion with the DAs revealed that due to the inadequate amount of production, the households are not motivated to get organized and negotiate thier rights. In fact, it was observed that there was no strong move by the DAs and even the office established to promote cooperatives towards forming such associations. Likewise, the focal person from World Vision Ethiopia (WVE-Boset Area Development Pogam) has also affirmed the weakness in forming associations and giving the required assistance.

When we look at *Iqub*, it is a rotating saving and credit type association whose members make regular contributions to a revolving loan fund. *Iqub* is a traditional self-help group in Ethiopia used to solve an immediate economic and social problem (Getasew, 2017). Among the participants of this study the regular money contribution for the *Iqub* is made on weekly basis. But as can be seen from Table 5.6 there are only few of the participants (12.2%) that were involved. As to the reason for less participation in such social organization, discussants informed that for most of them it is difficult to mobilize cash money on weekly basis unless engaged in

some form of non-farm activities like petty trading. Of course, this view is also recognized by Getasew (2017) in his study that the participants of *Iqub* are decreasing mainly due to the rising cost of living.

Among the informal institutions available in the study area one is borrowing money from each other. It is said that informal finance is a regular feature of poor people's lives (Johnson and Rogaly, 1997). With this recognition, during the FGDs it was raised that in all the sample *kebeles* lack of credit service was a serious problem. Consequently, discussants mentioned that, especially during sowing time when there is serious lack of adequate seeds to plant prevails, the rural households will go to private money lenders. In order to get a loan, the borrowers were first required to engage in some physical work for some days. Besides, the borrowers were expected to pay back with high interest rate with an obligation to sell their products to the loaner with cheap prices. Similar finding was also obtained by Johnson and Rogaly (1997) in Indonesia that crop traders provide producers with seasonal credit on the understanding that the crop is sold through the same trader at low post-harvest prices. Besides, Bidisha *et al.* (2016) have observed the same situation and explained that in the absence of low-cost financial services, poor households can respond to shocks only by borrowing at a much higher interest rate. As a consequence, Johnson and Rogaly (1997) emphasized that tied credits can maintain and even exacerbate inequalities in power and position.

As the informal institutions are more embedded within the culture of the people in the rural areas, key informants and discussants agreed that there is a declining trend. Participants informed that sympathy for those who need assistance is dwindling, except for the elderly people and women who insist on the usefulness of this institution. As to the reasons, participants raised issue of growing incidence of poverty and partly the influence of 'civilization', i.e. a tendency towards self-love and accumulation of wealth by the few. Of course, such phenomena of the declining roles of informal institutions was also witnessed by Ali (2008) due to the fact that poverty within the community is eroding the culture of helping each other. As has been discussed, the roles played by the informal institutions are diverse and significant which deserve to be harnessed. Hence, local authorities may need to pay attention to such arrangements and work on strengthening them so that members could be empowered to solve problems by themselves.

5.4.3 The roles of formal institutions

Provision of different agricultural extension services is one of the roles formal institutions could play in order to improve the livelihood of rural households and resolve food insecurity in the mean time. This is possible in the sense that such services are supposed to enhance productivity of farmers by educating them so that they will be acquainted with new skills, facilitate the access to modern inputs, be aware of the availability of new technologies so they can easily adopt new technologies, to mention few.

Taking these facts into account, respondents were made to identify whether they have access to agricultual extension services. Households that constitute 80.4% (*n*=319) replied to have access for agricultual extension services, the remaining 19.6% (*n*=78) responded they did not have the access. Likewise, those respondents who have access to agricultual extension services have identified the kinds of services they obtain which were comprised of training on new techniques of farming (93.1%), advice on different agricultural practices (54.2%) and others (Table 5.7).

Table 5.7 Kinds of services respondents get from DAs (Multiple responses)

Kinds of agricultual extension services	Responses		Percent of Cases
	n	Percent	
Training on new techniques of farming	297	43.7	93.1
Advice on different agricultural practices	173	25.4	54.2
Facilitating access for modern inputs	113	16.6	35.4
Information on climate variables	97	14.3	30.4
Total	680	100.0	213.2

On the other hand, respondents who did not have access to the agricultual extension services have also distinguished the reasons for not getting the services that include discrimination (52.6%), being not interested in getting the agricultual extension services (42.3%), and lack of commitment by the DAs (5.1%). However, the key informant interviews, focus group discussions, and informal discussions made with the residents revealed that the DAs are running after the model farmers ignoring the masses. The participants justified that the model farmers are economically capable who can apply what is suggested by the DAs and serve as a demonstration piece when higher officials are coming to the *kebeles*. One key informant expressed, the

surprising thing among the higher officials is that they just visit those model farmers and go back without commenting on those who are not performing well.

Furthermore, key informants from the different sample *kebeles* expressed that some farmers were not interested in the agricultual extension services because the services are not purely for the sake of improving wellbeing of the population in the district, rather DAs were serving to calm down them. During an informal discussion one key informant stated "had the commitment of the DAs and other district level workers been like what was observed during election time, food insecurity and even poverty could be history". Of course, a document prepared by Kassahun (2012) has come up with similar finding that the ongoing agricultural extension scheme was "… aimed at effectively controlling the bulk of the Ethiopian electorate whose votes in periodic elections are crucial to the regime's perpetuation in power" (p. 2). In a similar vein, Elias and colleagues (2015) have indeed found in North West Ethiopia that undefined boundary between the extension service and the local politics is one reason for farmers' dissatisfaction with the agricultural extension service.

A simple look at the number of respondents who have claimed to have access for the agricultual extension services appears really an encouraging fact. However, findings of empirical studies show the performance of the DAs is surrounded by different limitations. For instance, Chemonics International Inc. (2015) expressed the concern that there exist gaps in the dissemination of knowledge which continue to limit the productivity of the agricultural systems. Similarly, Degefa (2005) has found that the introduction of the agricultural extension program has mixed results. As to the reason for such a mixed result, Degefa (2005) explained that it could emanate from a failure to design different agricultural extension packages suited to various agro-climates and the diverse farming systems.

In a document that was entirely devoted to understand the political economy of the agricultural extension program of Ethiopia, Kassahun (2012) has identified that the agricultural extension program has been playing an important dual role. These roles constitute serving as a strategy for promoting broad-based agricultural growth, and also it functions as a valuable tool for political control and mobilization across the country (Kassahun, 2012, p. 2). But Kassahun (2012, p. 3) cautioned that "… the control imperative is leading to a less flexible and responsive service for farmers, thereby reducing its productivity and growth impacts".

We have also considered health education and provision of different health services as the other roles which are so crucial in minimizing the consequences of food insecurity that formal institutions could provide. Cognizant of this fact, it was found that 73.3% (*n*=291) of the respondents have access to health extension services, while the remaining 26.7% (*n*=106) did not have access to the services.

It is good to see almost three-fourth of the households have access to the health extension services. But a closer scrutiny of the facts showed among the services the dominant one was provision of family planning services. During an informal discussion it was observed that the health extension workers are mainly occupied with this family planning services giving little attention to the child care, sanitation and hygiene components.

The other important roles of formal institutions that could have a remarkable contribution in tackling food insecurity is access to credit. In our study among the total respondents only 28.2% of them have access to credit services whenever they require (Figure 5.1).

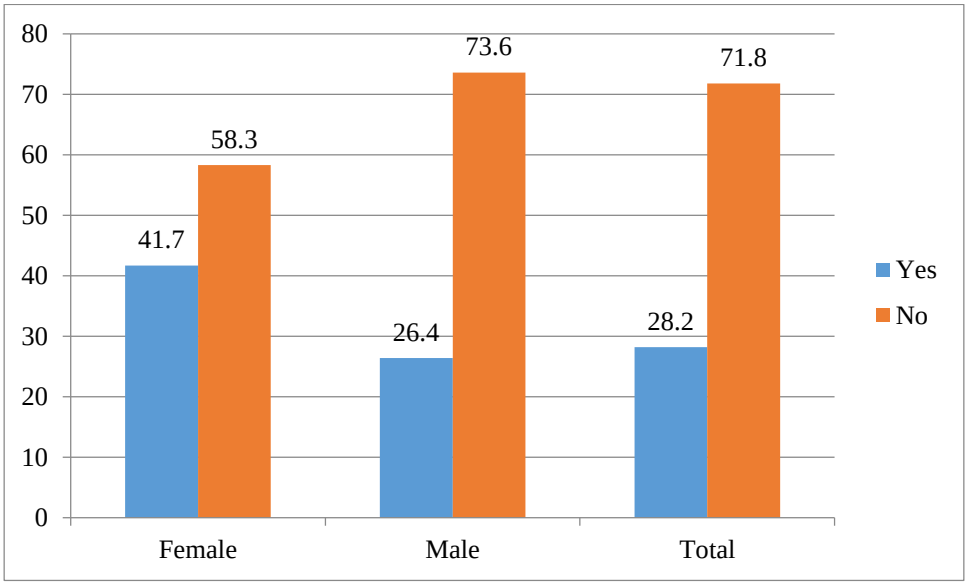

Figure 5.1 Respondents access to credit services whenever they require

It was observed from Figure 5.1 that female household heads have better access to credit services than their male counterparts with statistical significance of less than 5% significance level. This could be partly because, according to Women's and Children's Affairs office head of the district, a tremendous effort was made to organize the women so that they could get access to credit after saving their own some amount of money. However, based on the finding presented in Figure 5.1

it can be observed that majority of the respondents were still denied of the benefits they could earn if they had access to credit services. It should be noted that the above figure refers to the results of female headed households against male headed households.

Similarly, Zeller and Sharma (2000) and Pieters *et al.* (2013) have confirmed that lack of access to credit remain a considerable problem for smallholders in developing countries. This is because, according to the authors, smallholders are often credit constrained because they lack assets to provide as collateral. However, it was argued due to the nature of food insecurity confronted by many of the poor households "… there is a potential demand for savings, credit and insurance services that more efficiently can contribute to consumption stabilization while at the same time enhancing income generation and self-employment" (Zeller & Sharma, 2000, p. 146).

The finding from those households who have access to credit services revealed there were different sources of credit (Table 5.8). Of course, results from Table 5.8 show sources of credit access which could be either formal or informal. Among those sources credit associations (56.3%) account for the largest share, followed by individual money lenders (34.8%), and relatives and/or friends (32.1%).

Table 5.8 Respondents' sources of credit access (Multiple responses)

Sources of credit access	Response		Percent of Cases
	n	Percent	
Credit associations	63	43.7	56.3
Individual money lenders	39	27.1	34.8
Relatives/Friends	36	25.0	32.1
Government organization	6	4.2	5.4
Total	144	100.0	128.6

Results of the finding from Table 5.8 show the significant share of individual money lenders as source of credit. This finding could indicate how much the borrowers could be manipulated by the individual money lenders.

In fact, respondents have also identified the purposes of the money they have borrowed. Thus, it was found that purchase of food (58.9%), purchase of modern inputs (47.3%), purchase of materials for children (32.1%), and purchase of livestock (15.2%) were purposes for borrowing.

The findings reported here are organized from multiple responses that respondents provided. It could be implied that most of the money borrowed was not utilized for productive purposes.

Besides what has been discussed so far on the roles played by the formal institutions, especially with regards to government organizations, it was also observed during informal and key informant interviews that almost all of the pertinent offices contacted complained shortage of budget, manpower, office facilities and logistics, and the inconvenience of offices. In addition, nowadays things were being done in the rural parts of the district through campaign in which office workers were in hurry simply to complete their assigned task. Indeed, during informal discussions there were workers who question the real contribution of such kind of undertakings. Given all these shortcomings that could greatly hamper the effort to improve overall livelihood and tackle the food insecurity, it can be deducted that the local formal institutions were not delivering what is expected of them, thereby their roles were perverted. Thus, in the words of Paul and colleagues (2016) it can be said "… government is neither absent nor prominent in the lives of the study households" (p. 131-132).

Furthermore, non-governmental organizations (NGOs) are among the formal institutions that have a stake in solving communities' problems by complementing on what the local authorities are lacking. According to the extension section team process owner of the agriculture office of Boset district, there are few NGOs operating in the district. Among them World Vision Ethiopia (WVE), Environmental Development Association (ENDA), and World Council of Credit Union are those which are actively working on food security and agricultural development. For this study, the roles of World Vision Ethiopia, Boset Area Development Program was scrutinized.

According to the focal person, WVE operates in five *kebeles* of Boset district with beneficiaries selected based on low rainfall, high population density, and inaccessibility criteria. The major activities WVE was engaged in include, among others, enhancing food and water security, land development program, creation of enabling environment by capacity building, and commercializing the rural economy. The focal person identified inadequate and erratic rain, deforestation, natural resource depletion, failure to get adequate gain from the market (due to manipulation of middlemen), lack of means to preserve perishable products, lack of quality inputs, and lack of active cooperatives working on market access as major causes of food insecurity in the district. As a coping strategy, households were involved in daily labour in Merti

and Africa Juice factories, petty trading, charcoal and firewood selling, renting out their land with cheap price, and taking loan from private money lenders. The focal person stressed that due to the frequent occurrence of the problem of food insecurity, high interest rate, and the cycle of renting out land, there is a big lose that constrain the recovery into a normal state.

The focal person has added that the poor working culture of the households, lack of commitment to diversify their livelihood, dependency thinking, lack of saving culture, and the priority given to big enterprises (like Expansion of Wonji Sugar Plantation) that took fertile land of the farmers were the biggest challenges that need a concerted effort. To the contrary, there are possibilities in which the rural households can get rid of the food insecurity problem. Those possibilities emanate from the fact that the younger generation are now involved in farming who are educated, energetic, and market oriented. The focal person added there is better access to information, the young are more receptive of technology, and availability of interventions by different actors which all play a crucial role in alleviating the problem.

In the attempt to evaluate the efforts made by these institutions, respondents were asked on the availability of NGOs who support them to overcome impacts of climate variability and/or food insecurity. Accordingly, about 57.2% (n=227) of the households acknowledged the existence of such organizations in their locality, whereas 42.8% (n=170) of the remaining households replied to have not witnessed the availability of NGOs.

Those respondents who witnessed the existence of NGOs in their locality have evaluated the services provided by such organizations in terms of giving a lasting solution to their problems. The result from the finding (Figure 5.2) shows the overwhelming majority (90.3%) of the respondents stated the support they were getting from the existing NGOs were not adequate.

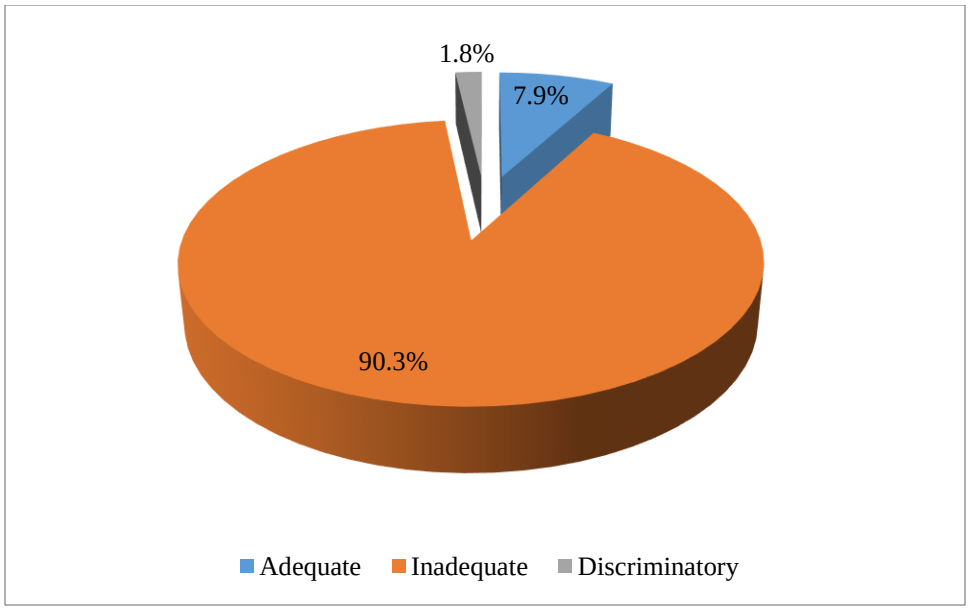

Figure 5.2 Evaluation of support obtained from the NGOs

Among those respondents who replied they have access to support from the NGOs, only 7.9% of them confirmed the adequacy of the services. Thus, it can be learned that the mere presence of organizations which did not address the needs of the households will not be expected to alleviate the food insecurity.

In fact, the finding on the inadequacy of the support provided by the NGOs was also felt by many workers at the district level. The workers complained the support provided by the NGOs on two grounds that the NGOs lack flexibility in responding to communities' problems and again the support they provide was not something that gives a lasting solution. One key informant from the elderly told that what they get was education materials whereas their problem is shortage of oxen and lack of improved seed that could help them produce more and feed their family members.

Contrary to the complain expressed by district level workers, the focal person on food security from World Vision Ethiopia (WVE) operating in Boset area development program, explained that the problem emanates from the expectation of the district workers. The focal person stated that the district workers did not consider themselves as partners, rather than complementing each other these workers bring some problems and leave it totally to be solved by the organization (i.e. WVE). He admitted what their organization has been providing may not be adequate but emphasized the issue that when budget is allocated, it is earmarked.

5.5 Conclusion and Recommendation

This study examined the causes of food insecurity and the roles played by institutions in averting the existing food insecurity. The findings show that food insecurity is caused by multiple factors which were reinforcing each other. It was observed that respondents were faced with frequent drought, farmland fragmentation and diminishing landholding size, highly constrained with absence of credit services and lack of cash that forced them to use traditional farm implements instead of modern inputs and new technologies, and poor saving culture coupled with lack of education, among others. All these causal factors do have both direct and indirect bearings on the food insecurity situation of households in the study area. Households were encountered with crop failure and reduced yield which directly affects their food insecurity status, or may face asset lose that in turn undermine their income, and limit availability of food. Among the causal factors examined lack of saving culture and poor working habits were the two important factors neglected by both the rural households themselves and the local authorities. Such neglect could lead to depletion of the meager resources at hand which finally lead households to be food insecure and remain poor.

The informal institutions examined show that their roles were minimum and even getting diminished due to the poverty situation and monetization of things. Besides, findings on the roles played by the formal institutions show the existence of a wide gap between what the formal institutions are supposed to provide and the reality on the ground. For instance, the intermingling of the agricultural extension service with local politics; the severe lack of credit services; the preoccupation of the health extension workers only on the family planning services; and the inadequate support and rigid approach of the NGO (i.e. WVE) are exemplars for the discrepancy with the reality. Therefore, interventions to be made in tackling food insecurity should be implemented based on the predominance of each causal factor across the *kebeles* in a multi-dimensional manner. In addition, our findings suggest the reorientation of the roles of informal institutions and creating system of accountability for the formal institutions. Future research may employ both qualitative and quantitative methods, with ample time in the field, to better identify the underlying factors for the declining roles of informal institutions.

Chapter 6: Conclusion and Recommendation

6.1 Introduction

The overriding purpose of this dissertation is to examine the interrelations between climate variability and vulnerability to food insecurity. In fact, this does not necessarily mean that food insecurity is caused by climate variability alone. Rather, the issue of climate variability is brought to give it more attention than the other causes as it is triggering more consequences. Given this, many previous studies conducted in Ethiopia have vigorously studied food insecurity and documented that food insecurity is recurrent and has been a big challenge. Notwithstanding all these efforts, the literature reviewed show some gaps in the empirical studies that served as a basis for conducting this study.

The first gap identified is that studies related to adaptation practices in Ethiopia were generally limited and spatially biased (Arragaw & Woldeamlak, 2016). Climate change and the unprecedented climate variability are now established facts of the current time which require a prompt action. Adaptation is just one way of abating the adverse effects of climate variability. Thus, knowing the adaptation strategies, barriers and the determinants to adaptation could be of great help in minimizing the concomitant problems of extreme weather events on the food security status besides adding up to the extant literature. That is what Davies (1996) contended for the fact that the inability of people to achieve food security is not an irreversible trend, if their attempts to adapt are supported.

Secondly, it was observed that vulnerability aspect of the Ethiopian rural households was overlooked (e.g. Lautze & Maxwell, 2007; Ali, 2008; Sandstrom & Juhola, 2017). It was evidenced that when studying food insecurity looking the current status and also the future prospect is of greater help. The vulnerability aspect can serve the latter purpose that could enable to reduce the likely damage. In addition, the vulnerability aspect gives the opportunity to look at food insecurity from different dimensions (i.e. biophysical and social) so that targeting and the solutions to be provided could be effective. Thus, in addition to adding to the scanty literature in the area, this study could motivate future researchers to consider vulnerability as an important issue for investigation.

The third point of concern noticed is the fact that so many studies including those recently undertaken by Alemseged (2016), Garedew (2017), and Abayineh & Belay (2017) used a single indicator to study food insecurity. To the contrary, food (*in*)security is known to be multi-dimensional and there has been no single indicator capable of measuring the multi-dimensional nature. Nowadays scholars in the area are advocating for using a suite of indicators to capture that multi-dimensionality. Hence, this study adopts multiple indicators to understand comprehensively the food insecurity situation of the study area. In addition to the methodological contribution, this study could inform future researchers not to be occupied with a single indicator which gives them a partial view of the reality on the ground.

Lastly, it was also obtained that studies conducted so far have not given due emphasis on the roles of institutions in curbing food insecurity. Institutions have both direct and indirect roles in facilitating or hampering the process of solving problems related to food insecurity. As the institutions investigated are local, contextual understanding could be obtained. Hence, a closer scrutiny is necessary to harness the benefits accrued and/or suggest corrective measures on the shortcomings of the institutions.

Given the above highlighted research gaps, it is strongly believed that, this study could contribute in filling the contextual knowledge gap. This is because the study has dealt with such big issues as adaptation strategies, vulnerability, food insecurity and roles of institutions in an integrated manner. In addition, the methodologies employed and results found could provide useful insights to solve problems of food insecurity.

In line with what are described in the preceding paragraphs, this chapter is organized in such a way to constitute summary of major findings together with the conclusion, synthesis of the overall study, practical and policy implications of the findings, and suggestions for further research. In the next section comes summary of major findings and discussion of their implications.

6.2 Summary of Key Findings and Conclusion

Summary of the key findings and their implications are presented in what follows.

i. Households' perception and experience on the effects of climate variability

With reference to the last 5-10 years, it was found in the study that an overwhelming majority of the respondents have perceived changes in temperature and rainfall. About 80% of the respondents claimed to have observed an increasing pattern of change in temperature. In contrast, significant number of respondents stated the pattern of rainfall showed more uncertainty and inadequacy. Even results from KIIs and FGDs corroborate with the survey finding stated. Similarly, a comparison made between what people perceived and the available meteorological data also revealed that the temperature over the last 10 years has changed with an increasing trend. Whereas, the meteorological data obtained refutes the perception on rainfall pattern, i.e. the rainfall recorded has remained more or less stable, though minimum like what it used to be. In fact, having such an overwhelming majority of respondents witnessed changes in temperature and rainfall could mean that some sort of unusual climate variability was happening in the study area.

However, climate variability could be a problem only when accompanied with the occurrence of frequent extreme weather events, such as drought and flooding. Cognizant of this fact, the finding showed 88.9% of respondents have noticed frequent drought occurrence.

Due to the frequent occurrence of drought, problems such as reduced yields, complete crop failure, and shortage of water both for animals and people were the perceived consequences experienced by the respondents. This particular finding could indeed show how the food insecurity situation of the study area can be explained by the climatic and environmental theories of food insecurity.

ii. Adaptation strategies of households for events of climate variability

It was explored in the study that respondents were not passive victims of the extreme weather events occurring in their surroundings. More than 90% of them have identified a number of adaptation strategies they have been pursuing. The adaptation strategies were grouped into three commonly cited adaptation options in this study. The first category was ‘crop management related strategies’ which comprise use of fertilizer, use of drought resistant crops, and use of different crop varieties. The second category was ‘land management related strategies’ that include soil and water conservation techniques, irrigation use, water harvesting, and planting trees. The final category is diversification into non-farm activities.

After identifying the adaptation strategies, a multinomial logit model was employed to look into the determinants of the adaptation strategies pursued so far. Accordingly, some variables which include gender, farmland size, total annual income, access to weather forecast, access to credit services, and distance to input/ output markets were found to have significant statistical influence in determining the adaptation options, though at varying levels. It can be observed that these variables have different signs across the adaptation strategies showing that the treatment of each variable should be in accordance to each adaptation option. In addition, those variables with statistical significance in this study were compared with other empirical studies which revealed that a variable which is statistically significant in this study may not be the same in others, besides the signs could vary across studies. Thus, this comparison has an important implication in that care should be taken when thinking about relevant interventions, as adaptation is context specific, the blanket approach may not hold true in all situations.

Furthermore, an attempt was made to distinguish the barriers to adaptation. As a result, households were confronted with so many barriers which include lack of access to finance, shortage of land, lack of water, lack of access to modern inputs, lack of market access, lack of technical support, and lack of information. Of course, existence of such multiple barriers to the rural households with already limited resources could mean that their resources could be overstretched and may increase the burden when some other weather extremes happen.

Among the barriers identified, some of them may deserve special mention and consideration. For example, the finding on lack of access to market appears to be unique in this study. This is because lack of access to market in this study refers not the physical access as one may guess; rather it deals with the manipulation of brokers (attested by focus group discussants and a key informant from World Vision Ethiopia, Boset Area Development Program). It was reported by key informants and discussants in this study that those households who have access to irrigation were not the prime beneficiaries of their produce. Due to meddling of the local brokers, the rural households were obliged to sell their products with lower prices, making the brokers and the rich merchants get richer. The sad thing is that the local authorities were reported doing little or even nothing to change the situation in favor of the rural households manipulated.

Furthermore, lack of access to modern inputs is another barrier that the respondents were confronted with, and which merits a discussion for some unexpected finding related to it. With

proper acknowledgment of the respective DAs in each of the sample *kebeles*, results from focus group discussants and key informants revealed the existence of severe shortage of modern inputs, especially improved seeds. Here, what is disappointing for the participants was the preferential treatment of the 'model' famers which were getting unfair advantage by claiming all those meager modern inputs that were brought in the name of a particular *kebele*. It was the 'model' farmers who got priority of the first generation improved seeds and easily access the fertilizer available. Here, it can be implied that caution should be taken that some development interventions could have unintended and/or unpleasant consequences as a result of the preferential treatment.

With regards to the constraints to adaptation, to give it a broader implication, it can be deducted that those barriers to adaptation may have a greater contribution to the food insecurity of the study area. This could be through forcing households remain in debt, the depletion and overstretching of resources found at the poor households' hand. Nonetheless, a closer examination shows the barriers could have been addressed by the local authorities' and their higher tiers so that the food insecurity situation and livelihood of the households could be improved for the better.

The other important concern considered in the study is whether households have access to weather forecast. To this end, the large majority of the households affirmed their access to weather forecast. This is indeed a good sign that respondents could be in a better position to take the required adaptation actions. Respondents identified radio/television, use of traditional knowledge, and the local DAs as their sources of information. However, it should be noted that information obtained from radio/television is generic in nature which may not fit the local context. Besides, the DAs were not better equipped to give more information on the weather forecast than the farmers. More importantly, it is worth mentioning about the decreasing value given to local/traditional knowledge, though it was gained from the accumulated knowledge of long lived experiences in line with that particular area. Thus, better to integrate this local indigenous knowledge with the modern sources to complement each other.

Another important issue that was disclosed is the timing of adaptation action. This was meant to know the habit and evaluate the effectiveness of adaptation efforts made by the households. This being the case, it was found that the large majority of households take adaptation actions in a

reactive manner, i.e. after being affected by the problems of climate variability and/or being informed by someone else. As a habit such an approach cannot be helpful since some damages could be irreversible, weaken the capacity of households, and complicate things which become difficult for recovery. Given the multiple barriers to the adaptation efforts and the ill-timing of adaptation actions 'what do the vulnerability levels of households to food insecurity look like' is the next issue elaborated.

iii. Levels of vulnerability to food insecurity for the households

To assess the vulnerability of households to food insecurity an integrated vulnerability assessment approach was employed. This approach is a widely accepted assessment approach in recent times and accommodates both the biophysical and social aspects of vulnerability. Consequently, the adaptive capacity, sensitivity, and exposure were examined as components of vulnerability. To determine the ultimate vulnerability level of households an index was constructed for each component and then combined net results of exposure and sensitivity were deducted from the corresponding adaptive capacity. After aggregating the vulnerability value of each household the overall vulnerability levels were determined.

Results of the survey finding showed that more than half of the total respondents were highly vulnerable, and only 18.9% were less vulnerable. More importantly, the finding depicted a statistically significant difference among the sample *kebeles* at *p*-value of less than 1% in terms of levels of vulnerability to food insecurity. When one looks at the results closely it can be observed that the high vulnerability could be due to the less opportunities for non-farm income, less availability of farm equipment, existence of minimal assistance by *kebeles*, and less access to credit services. On the other hand, the high exposure to extreme weather events and the high sensitivity of the livelihood of households which is dependent on agriculture were the contributing factors for the prevailing high vulnerability to food insecurity. Given such levels of vulnerability, therefore, it can be drawn that the future prospect of food security in the study area is gloomy and demands a strong collaborative action between various stakeholders.

iv. Food insecurity situation of households in the study area

To understand the food insecurity situation with all its dimensions a suite of indicators was employed. Based on validation studies and suggestions of scholars MAHFP, HFIAS, HDDS, and

elements of WASH were used as indicators to measure the status of households. Accordingly, findings showed consistent results in that large majority of the households were found to be food insecure despite the use of any of the indicators. To be more specific, 91.7%, 60.2%, and 85.6% of respondents were found food insecure through MAHFP, HFIAS, and HDDS, respectively. In addition, more worrisome is that respondents that account for 56.9% did not have access to clean water; 46.1% did not own latrines; and again 64.0% of the total respondents disposed waste in unsafe way. Of course, it should be noted that the reason why the number of food insecure households appear to be high could be partly because data were collected during the lean time in the study area.

In addition, it was obtained in the study that the households were using different sources of getting food which include own production, purchasing from the market, through food aid, and by borrowing. However, a closer look at some of the sources of food indicates that care must be taken not to further complicate the consequences of food insecurity. For instance, since the overwhelming majority of the households were subsistence farmers, who spend lots of their income for food, reliance on markets may have bad consequences especially at times of higher price rises of staple foods. Similarly, food aid may have unintended negative consequences when it acts as a disincentive for self-reliance due to the resulting dependency syndrome. The resistance of households not to graduate from the PSNP may exemplify this point.

In similar way, households were again found employing different mechanisms of filling the food gap created. These mechanisms involve working in food for work, casual labor, food aid, borrowing, remittance, and from non-farm activities. Diversification of the mechanisms for filling the food gaps is good, but the mechanisms did not appear to be lasting longer and viable for the rural population unless ways are sought to enable them overcome the concomitant problems of food insecurity. The reason for saying those mechanisms are not lasting longer and viable is that they are time bounded or they are not available on permanent basis, rather it is the context that dectates their availability.

To know the variables that determine the food (*in*)security situation of the households investigated, a binary logit regression model was applied. The results from the model revealed some variables improve the food security situation while others constrain the achievement of food security, having statistically significant effect though the levels were different. From the

variables considered educational status, farmland size, total annual income, and availability of supporting organizations were positively contributing for food security of the respondents. Thus, all concerned parties including local authorities and NGOs operating in the area could focus on such variables to hasten the process of achieving food security. Whereas variables such as access to irrigable land, frequent occurrence of drought, distance from input and/or output markets, and distance from road transport were found aggravating food insecurity of the households. The finding on access to irrigation contributing negatively to the food security of households seems surprising. However, this could be the case due to the fact that irrigation requires the use of modern inputs which are both expensive and unavailable. Despite the price and unavailability, households will try their best to apply those inputs. Nonetheless, as discussed in Chapter 2, due to the meddling of the brokers those households were not the prime beneficiaries of their sweat, rather put the households in a debt spiral.

Findings related to the food insecurity situation of households in general may suggest that the problem is really a big challenge and a critical concern of the study area. This is because when such a large number of populations were food insecure, as revealed through the suite of indicators, the repercussions of food insecurity from the resulting consequences could be far reaching.

v. Causes of the prevailing food insecurity

Prior to looking at each of the causes of food insecurity in the study area, the causes were classified into five categories. This was made not to overlook each of the causes identified from literature reviewed and those suggested by experts in the field. The categories are comprised of environmental, demographic, economic, physical, and social reasons. In this study it was confirmed that food insecurity was caused by multiple factors.

Among the causal factors the top ones found from each category include frequent drought, diminishing landholding size, lack of cash, lack of credit services, and poor saving culture. These causal factors may show how the interventions to tackle food insecurity should be diversified. Similarly, the results also imply that more attention should be paid on each of these causal factors for the interventions to be effective.

The multiple causes of the prevailing food insecurity could also justify the use of more than one theoretical orientations to give a comprehensive explanation of the food insecurity situation in the study area. For instance, the frequent drought and inadequate rainfall could result in reduced crop yield and complete crop failure that could culminate in food insecurity which is in line with the climate and environmental theories of food insecurity. Likewise, the failure to have cash, lack of access to credit, low modern input use, lack of education, and lack of food aid could show the applicability of the political economy explanation of food insecurity. Furthermore, in line with the third theoretical orientation that considers food insecurity as an outcome of vulnerable livelihood, it can be described that when drought is occurring more frequently coupled with crop failure and reduced yield, households could be obliged to deplete the asset they have that will make them more vulnerable and finally food insecure. Given the frequent occurrence of extreme weather events, the multiple barriers to adaptation, the prevailing food insecurity, the vulnerability levels observed, and the multiple causes of food insecurity, in the next section comes examination of the roles of institutions in tackling problems of food insecurity.

vi. Institutions supporting or constraining to address food insecurity in the face of climate variability

The roles of both formal and informal institutions in curbing the problems of food insecurity were examined separately. We found that the informal institutions available in the study area were not that much helpful in tackling the prevailing food insecurity. To illustrate, the existing social organizations have stacked in their traditional roles, i.e. providing food and comforting those families whose member has deceased. Similarly, the other informal institutions which are meant to mobilize labor were organized most of the time by those rich farmers who can afford to prepare the feast. It was reported that roles of these institutions have become a sort of ‘tit-for-tat’. In addition, the weak working culture and the extravagancy observed were elements of the informal institutions overlooked by the households themselves and the local authorities in general which could even aggravate the food insecurity situation of the households. In fact, the diminishing roles of informal institutions were also recognized by other scholars like Ali (2008), Ephrem (2010) and Abate (2013). In addition, Devereux (2001) has also documented that as

drought frequently occurs access to food through local 'moral economy' transfers could be threatened.

The evaluation on the roles of formal institutions was also found to be inadequate and unsustainable. To exemplify this, one can consider the double roles of the DAs in the sample *kebeles*; the roles of health extension workers being confined to the provision of family planning services; the insignificant number of households having access to formal credit services and the consequent manipulation of local money lenders; lack of commitment by district level employees to perform activities beyond their traditional office work; and the rigid approach and inadequate services provided by NGOs operating in the area. The findings on the roles of formal institutions were found to align with the political economy theoretical orientation which was considered in this study. This could be justified by the fact that the interventions made so far were inadequate, untimely, and biased towards those who have close contact (the model farmers in this case) with government authorities.

6.3 Synthesis of Findings

The focus of this section is of twofold. First, to see the possible link between variables of interest which include climate variability, adaptation, vulnerability to food insecurity, and roles of institutions; second an attempt is also made to uncover the likely contributions of the study, risking not to repeat findings discussed in the other sections. Even though the study has focused on Boset district of East Shewa zone in Oromia National Regional State, it is believed that it has theoretical and methodological relevance reaching beyond the study area.

From the discussions made so far on the major findings, it can be learned that climate variability was occurring in the study area in unusual way in the form of increased temperature and the occurrence of more frequent drought leading to decrease in yield and even complete crop failure. Besides, it was observed that almost all of the respondents have perceived the unprecedented occurrence of elements of climate variability. But it should be noted that awareness creation cannot and should not be taken as an end by itself. Of course, the discrepancy between effective adaptations and awareness could be due to the fact that so many adaptation barriers prevail in the area which could have a wider implication even on the livelihood of the households under study. On top of this, the local authorities operating in 'business-as-usual' way was not enabling to minimize households' burden, let alone solve their pressing problems. The approach of local

authorities is said ‘business-as-usual’ because the farmers were observed using oxen, wooden plough with the iron, below standard modern inputs, among others.

The frequent occurrence of extreme weather events, especially drought, may indicate the downward spiral that people could be dragged into impoverishment that increases their vulnerability. To combat such adverse effects of climate variability, households were employing various adaptation strategies which suit their local context. Despite this fact, however, their efforts were constrained by the multiple barriers they were confronted with. Given such multitude of barriers to adaptation, the small resources the households command will be overstretched that make the adaptation actions less effective which in turn end in difficulty of preventing from the resulting food insecurity. To make matters worse, it was found that both the formal and informal institutions existing in the study area provided inadequate services in tackling the extreme weather events and food insecurity in particular. Hence, it is because of the cummulative effects of frequent drought, constrained adaptation actions coupled with the ineffective roles of institutions that food insecurity and vulnerability were found to be high in the study area. Of course, it can be drawn that there is convergence of findings in terms of increasing trends of temperature, the high awareness level on the prevailing climate variability, and the existence of multiple barriers to adaptation. On the other side, our study finding diverges from others in that we found a mixed trend of rainfall variability, while others claim the existence of decreasing trend; in addition, a variable that has statistically significant effect in our study may not do so in other studies showing the contextual nature of adaptation strategies.

As far as theoretical implications of the findings are concerned, the prevailing food insecurity could be explained by the three theoretical orientations identified in the Introduction chapter of this dissertation. First, the unprecedented occurrences of increased temperature coupled with the erratic nature of rainfall were resulting complete crop failure, reduced yield, and shortage of water. These have a direct bearing on the food insecurity situation of the study area that confirms the suitability of the climatic and environmental theories of food insecurity as advanced by Markos (1997), Devereux (2001), and Wisner *et al.* (2004).

Second, the high exposure of the households to the extreme weather events and the sensitivity of their livelihood (because they relied heavily on agriculture) were observed leading to reduced yield and complete crop failures. This will in turn result in exhaustion of resources and reduced

income, forcing households to borrow and enter into a cycle of indebtedness that erode the resource base and increase the vulnerability of households. When such scenario is happening frequently, the vulnerability level of households will increase the probability that households could be food insecure. This issue is what the 'food insecurity as an outcome of vulnerable livelihood' theory argued for and which is proven by scholars like Ellis (2000), Degefa (2005; 2010), Allison and Hermans (2006), and Connolly-Boutin and Smit (2016).

Thirdly, it was found that there were so many circumstances like less access to credit, poor awareness on saving culture, lack of a system of accountability, poor expansion of infrastructure, and others that the government authorities could have provided so as to tackle the prevailing food insecurity. Even more specifically, households were found constrained directly by the government authorities not to expand their irrigation base which could help them diversify and minimize their reliance on rainfed agriculture. All these findings again justify the relevance of the political economy explanation of food insecurity as also elucidated by Mesfin (1986), de Waal (1997), Cohen and Werker (2008), Vadala (2009), and Aabo and Kring (2012).

In general, it should be noted that the livelihood of the rural households investigated was mainly dependent on agriculture, in which this sector is highly sensitive to occurrences of extreme weather events. It is also evident that the households were already suffering from the vagaries of extreme weather events. Even though the households and local authorities were trying to minimize the ill-effects of the extreme weather events, it was found that the proportion of the population who were food insecure and vulnerable to food insecurity was insurmountable. This may indicate that the business-as-usual approach of tackling food insecurity is no more feasible. Hence, a new mode of thinking and reorientation of the approach being implemented is a call of the time. More important to emphasize here is the need for *practical action* rather than the leap service that the people were accustomed to.

When one looks at the contribution of this particular study, first, along with the works of other scholars, this study provides an important insight in that food insecurity could be solved when due consideration is given for elements of climate variability and the concomitant problems, adaptation strategies and the prevailing barriers. Besides, vulnerability aspect of the rural households, the causes of food insecurity, and the roles played by institutions equally deserve

attention of the pertinent stakeholders. These issues, in general, point out areas of effective interventions to solve problems of food insecurity as well as vulnerability to food insecurity.

Second, it was observed that food insecurity was caused by multiple factors which could reinforce each other. This may signify the fact that 'playing the blame game' by the incumbent authorities should be challenged. Here, there is a convergence of findings conducted in different areas that causes of food insecurity are multiple implying that attribution to a single causal factor could be a huge mistake. As far as measurement of food insecurity is concerned, our findings have shown the deprivation of the rural households in all dimensions of food (*in*)security. Hence, in order to have a comprehensive understanding of the food insecurity situation and come-up with a workable solution, the use of a suite of indicators is highly commendable. It is also possible to see how helpful it is to use a mixed methods approach that allows the use of multiple sources of data in a flexible manner. Although cutoff points for the variables measured vary that prove to be difficult to make comparisons, in general it can be observed from findings of the different studies that food insecurity is still a big challenge for the rural population in Ethiopia.

Thirdly, this study provides an important insight with respect to how plausible the uses of multiple theoretical underpinnings are. To this end, it was reaffirmed that findings of this study are congruent with the propositions of climatic and environmental theories; the theory which states food insecurity as an outcome of vulnerable livelihood; and the political economy explanation of food insecurity. Thus, it can be implied that an eclectic approach of looking at the explanations of food insecurity could be more powerful and helpful in understanding comprehensively and also in search of feasible solutions.

6.4 Practical and Policy Implications

The findings of this study have important practical and policy implications for the rural households living in the study area, the local authorities and their higher tiers, and the NGOs working in the locality. It was observed that the rural households were earning their living despite the existing vagaries of climate variability. Besides, it was found that determinants of adaptation strategies vary across the available options and across studies. Similarly, determinants of food insecurity also vary across empirical studies. All these show the contextual nature of adaptation and food insecurity which imply that the blanket approach of solving such problems should be handled with great care.

Based on the evidences obtained from this study there are so many areas that require interventions by the different stakeholders available in the locality so that lasting solutions can be offered to solve problems of food insecurity. It is contended that addressing food insecurity in the study area requires a multifaceted and multi-sectoral approach. This is because as the causes of food insecurity are multiple, the solutions to be offered should also be multi-dimensional and undertaken in a collaborative manner. However, to be more pragmatic, in this section focus is given on those major actors and issues of serious concern.

Households

The prime responsible actors in alleviating the food insecurity problems which were resulted due to climate variability and other reasons are the rural households themselves. First of all, households should develop 'I can do' attitude to get out of their unpleasant situation. This is because, unless the households develop self-confidence in solving their own problems, always waiting someone else will not end the problems they have encountered. Rather, the households should commit themselves to be part of the solution to improve their livelihood. Certainly, a good opportunity available to the households is to learn from the model farmers. Some of the model farmers could serve as motivating forces in which their experiences could be replicated. Thus, results of this study could serve as a wakeup call for the households to own and solve the problems they encountered with their own resources and by themselves. This is what could bring them satisfaction and sustainability in the solutions they implemented.

Moreover, it was observed that so many households spend the hard earned money for feasts, purchase of household utensils, and enjoy in the nearby towns right after the harvest time. Such kind of practices could lead to extravagancy since they are mainly unplanned. The point here is that unless households exercise saving, there will be no way to mobilize resources when encountered with some shocks. Thus, the first step to be taken is to deter from selling crops immediately after harvest. Likewise, for the sake of efficiency, households should use their time wisely and mobilize household labor power rather than hiring someone else for which they can accomplish by themselves.

It was also learned that most households hesitate and resist the advices provided by the DAs. This can be considered as a missed opportunity since the DAs are there to help the households and the suggestions provided by the DAs are science-based. Besides, when a household is faced

with a problem and if that was found to be beyond the DA's capacity, the DA immediately informs to the district level experts so that solution could be sought. Consequently, better communication with the DAs could benefit households in many ways. To this end, households may need to open their mind and be receptive to new things and advices.

Local authorities

In the study area it was observed that local authorities (i.e. government workers at the distict level) seem to be complacent with what they have been doing, but the empirical findings show there were wide discrepancies. For instance, shortages of modern agricultural inputs (esp. improved seed); lack of access to credit services; lack of access to safe drinking water; the manipulation of households by local brokers; and, the inability to use Awash River for irrigation purpose were few of the problems households were confronted with and which were not addressed due to the inadequate services provided by the local authorities.

Of course, it is known that the formal institutions established at the district level are there to provide viable solutions to their constituents. This being the case, there are lots of things the local authorities may do to improve the existing situation. To start with, the local authorities may need to work on the *real* engagement of the households concerned in order to tap this resource and for the sake of sustainability. The other areas of concern that are suggested for improvement include: enhancing the capacity of individual households through creation of loan system (i.e. economic empowerment); providing early warning system; provision of access to irrigation services from the Awash River which crosses their district; protecting those households with irrigation access from the manipulation of brokers; creating system of accessing improved seeds (which was constrained due to unavailability and poverty); and promotion of crop storage facilities together with education on time of selling products.

Furthermore, since population pressure was already high in the area, increasing agricultural productivity and enhancing the adaptive capacity through increased asset portfolio of the households appear to be a viable option. At this junction introducing new and appropriate technologies could play a vital role in improving farmers' yields and overall livelihood. Many scholars have come to the consensus that achieving agricultural productivity growth will not be possible without developing and disseminating yield-increasing technologies. Indeed, technology has got an added advantage in that it potentially takes the pressure off natural resources that are

being depleted in local contexts. However, it should be noted that what are recommended above seem to exist but the *real practice* is seriously lacking.

The other important area that requires the interventions of local authorities is in strengthening the roles of informal institutions. It was evidenced that mainly due to poverty and some influences of 'civilization', the crucial roles of local institutions were eroded. Local authorities may need to work on the revival of those crucial roles played by the informal institutions through public discussions, promoting and strengthening the existing local institutions to accommodate development issues, and through economic empowerment.

In this globalizing world things are changing fast and so should be the way solutions are provided for the people concerned. Thereby, especially the local authorities (at the district level) and their higher tiers may need to revisit the development interventions being implemented; provide what they promise (like credit, water, road, and other facilities); work in coordination and partnership with all concerned stakeholders; empower the DAs and other district level workers to facilitate problem solving in the study area. Most importantly, a system of accountability may need to be created for the sake of making check and balance on what is being delivered, i.e. to confirm whether they are 'walking-the-talk'. To illustrate, it was witnessed that workers at the district offices were more worried about being available in the compound rather than the things they should accomplish on daily basis. This can be again evidenced by the difficulty one could encounter if in need to get a specific data. The other evidence could be the fact that the failure to follow up the seedlings planted on yearly basis (as the key informant mentioned the survival rate of the seedlings was not totally known).

NGOs operating in the area

NGOs operating in the study area were playing a crucial role in complementing what the local authorities are doing. Such things as commercialization of rural economy, capacity building through training and technical support, provision of education materials for households, and improving food and water security are some of the major activities undertaken by one of the NGOs (i.e. World Vision Ethiopia). However, from results of discussions made with some experts of the district and the rural households, it can be learned that the services of WVE were not helping to the extent they wish to solve problems of the society. Thus, it is recommended that the NGOs should work on demand driven basis (not simply because they come with the money);

they better adopt a flexible approach to accommodate the interests of rural households; develop a spirit of partnership with government sector offices; and work on solving problems of communities taking into account sustainability of the solutions they are providing.

Policy makers

Although this study is primarily aimed at unravelling climate variability and food insecurity situations at the district level, there are issues that beg the attention of higher level officials. The policy makers are those authorities found at the regional and federal government levels. It can be observed that, despite the awareness that the policy makers may have on the importance of the bottom up approach, the practice does not seem to coincide. This is because everything is initiated and implemented in the district following directives from the higher teirs. To be more effective and tap resources found within the society, policy makers may need to embrace the bottom up approach in practice so that contextual bases are taken for granted. Thus, policy makers may need to avoid the blanket approach in enforcing policies to be implemented. The other important concern is that there should be a periodic evaluation on the outcomes of development policies and programs. This is due to the fact that things are changing dynamically so should be the solutions to be pursued.

6.5 Suggestions for Further Research

As was evidenced by works of scholars in food security and a closer look at the widely accepted definition that was provided in 1996's World Food Summit, measurement of food insecurity should be pursued further using a suite of indicators. Considering one indicator could reveal only a partial dimension of the food insecurity situation, and cannot say what has happened to the other dimensions. Thus, it can be suggested that the use of multiple indicators is undoubtedly necessary to have a comprehensive understanding of the food insecurity situation. This suggestion has to do with the need to find out the right combination of the suite of indicators.

Secondly, this study was conducted using a cross-sectional research design which could make it denied of looking at the effects of time. Here, taking into account the seasonal nature of food insecurity and vulnerability, it is better to conduct further research using longitudinal data. This will enable to confirm consistence of findings and then act accordingly. Collection of time series data and conducting analysis accordingly could help better understand the trends and dynamics

of food insecurity status and the vulnerability of households' overtime. Likewise, to enrich what is obtained through quantitative methods, it will be important to stay longer in the field and generate more qualitative data.

Thirdly, it can be learned from the findings that so many households were found to be highly vulnerable to food insecurity. These large numbers of highly vulnerable households could necessitate the need to reverse the situation through adopting a resilience approach. Hence, further research is required to identify the ways as to how to enhance the ability of households to persist under fluctuating conditions.

Finally, looking at the interplay of climate variability and vulnerability to food insecurity could merit from the use of a multidisciplinary approach so that the issues would be understood in a deeper and broader way. Thus, future researches that aim to have a wider impact may need to employ this approach for a meaningful change.

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Appendices

Appendix I. Household Survey Questionnaire

Dear Sir/Madam,

This is a survey questionnaire designed to collect data and analyze on **Climate Variability and Households' Vulnerability to Food Insecurity** in Ethiopia, the Case of Boset District, East Shewa, as part of a PhD dissertation work. Your responses to each item of the questionnaire are very much crucial for the success of this study. Thus, you are kindly requested to give a genuine answer for each of the questions outlined. Finally, the researcher wants to assure you that your responses will be kept confidential and only used for the above stated purpose.

Thank you in advance for your time and participation.

I. Background Information

S.No.	Questions	Response categories
1	Name of household head	
2	*Kebele*	
3	Sex of household head	1. Male 2. Female
4	Age of household head	_____ years
5	Marital status of household head	1. Single 2. Married 3. Divorced 4. Widowed
6	Religion of household head	1. Muslim 2. Orthodox 3. Protestant 4. Catholic 5. "Wakefetta" 6. Others (specify)_____
7	Ethnic background of the household head	1. Oromo 2. Amhara 3. Gurage 4. Others (specify) _____
8	Educational status of the household head	1. Illiterate 2. Elementary (1-4) 3. Junior (5-8) 4. High school (9-12) 5. Others (specify) _____
9	Number of permanent members in the household, including the head	1. Male = _____ 2. Female = _____ 3. Total = _____
10	What has happened to the size of your household in the last 5-10 years?	1. Increased 2. Decreased 3. Not changed
11	If it has **decreased**, what is the reason?	1. Death 2. Migration 3. Separation/Divorce 4. Marriage 5. Other (specify) _____
12	Age distribution of members of the household	1. Less than 9 years = _____ 2. Between 10 and 14 = _____ 3. Between 15-64 = _____ 4. Above 65 years = _____
13	Are there members of the household who are engaged in non-farm activities?	1. Yes 2. No
14	If your answer is **yes**, what are the activities they are involved in?	1. Selling local drinks 3. Making handicrafts 2. Petty trading 4. Selling forest products

II. Asset ownership and Sources of Income of Households

S.No.	Questions	Response categories
15	Do you have land for farming?	1. Yes 2. No
16	If your answer is **Yes**, how do you get it?	1. Redistribution by *kebele* 2. Through gift from parents 3. Share-cropping 4. Renting 5. Purchased 6. A combination of the above, please mention _____
17	How much is your farming land?	_____ hectares
18	What has happened to your land holding over the last ten years?	1. Increased 2. Decreased 3. No change
19	If your response is **decreased**, what is the reason?	1. Shared with children 2. Redistribution of land 3. Abandoned due to decline in quality of land 4.Other (specify) _____
20	What has happened to your level of crop production over the last 5-10 years?	1. Increased 2. Decreased 3. Not changed
21	If it has **decreased**, what do you think are the reasons?	1. Lack of access to modern inputs 2. Due to recurrence of drought 3. Due to recurrence of flooding 4. Due to land degradation 5. Inability to purchase modern inputs 6. Prevalence of pest and diseases 7. Others (specify) _____
22	How many years have you been in farming?	_____ years
23	How many livestock do you own?	1. Oxen = _____ 5. Sheep = _____ 2. Cow = _____ 6. Donkey = _____ 3. Calves = _____ 7. Camels = _____ 4. Goats = _____ 8. Poultry = _____
24	What are the main problems you faced in relation to livestock production?	1. Shortage of feed for animals 2. Animal disease 3. Shortage of open space for keeping 4. Lack of better breeds 5. Lack of veterinary services 6. Shortage of water 7. Others (specify) _____
25	Do you have access to communal resources?	1. Yes 2. No
26	If your answer is **Yes**, what are these resources?	1. Grazing land 2. Forest 3. Construction material (sand and stone) 4. Others (specify) _____
27	Do you have access to irrigable land?	1. Yes 2. No
28	If your answer is **Yes**, what is the size of your irrigable land?	_____ hectares

29	How much money do you get from the following sources in 2006/07 EC crop year?	**Income sources**	**Amount in Birr**
		1. Livestock and livestock products sale	
		2. Grain sale	
		3. Poultry and its products sale	
		4. Firewood and grass sale	
		5. Charcoal and *kubet* (cow-dung cake) sale	
		6. Local drinks sale	
		7. Petty trading	
		8. Rural credit	
		9. Labor wage	
		10. Sale of sand and stone	
		11. Remittance	
		12. Others (specify) _____	
30	Who is in control of the household income?	1. The husband 2. The wife 3. Both	

III. Perception and perceived consequences of climate variability

S.no.	Questions	Response categories
31	Have you noticed changes in temperature over the last 5-10 years?	1. Yes 2. No
32	If your answer is **Yes**, what has happened to the temperature?	1. Increased 3. Fluctuated 2. Decreased
33	Have you noticed changes in rainfall patterns over the last 5-10 years?	1. Yes 2. No
34	If your answer is **Yes**, what has happened to the rainfall pattern?	1. Comes late and ends early 2. Comes late with dry spells 3. Overall shortage of rainfall 4. Comes late and with high intensities
35	Have you noticed changes in drought frequency compared to the last 5-10 years?	1. Yes 2. No
36	If your answer is **Yes**, how frequent drought occurs within the last 10 years?	_____
37	What are the problems you faced due to drought?	1. Complete crop failure 2. Reduced yields 3. Diseases/health problems/sickness has increased 4. Shortage of water both for animals and people 5. Others (specify) _____
38	Have you noticed changes in flood occurrence in the last 5-10 years?	1. Yes 2. No
39	If your answer is **Yes**, how frequent does flood occur?	_____
40	What kind of problems you encountered due to flooding?	1. Rotting of tuber and roots 2. Increased fungal diseases

		3. Reduced yield 4. Soil erosion 5. Reduced farmland 6. Destroyed food stores 7. Destroyed assets (like farm equipment)
41	What has happened to the cold during the summer season?	1. Increased 2. Decreased 3. Not changed
42	What are the major natural disasters you predict will occur from climate variability"?	1. Drought 2. Flood 3. Salinity 4. Water-logging

IV. Issues related to adaptation practices

S.No	Questions	Response categories		
43	Do you have access to weather forecasts?	1. Yes 2. No		
44	If your answer is **Yes**, from where do you get these weather forecasts?	1. Use traditional knowledge 2. From extension agents 3. From radio/television 4. Other sources (specify) _____		
45	Based on the information you obtained, do you take any adaptation action?	1. Yes 2. No		
46	If your answer is **Yes**, which are the adaptation strategies you pursue to overcome problems of climate variability? (**Note**: Put 1 if applied or 2 if not applied the specified strategy)	Adaptation strategies	Applied	Not applied
		1. Using different crop varieties		
		2. Changing planting dates		
		3. Adopting drought resistant crops		
		4. Increased use of soil and water conservation techniques		
		5. Diversification into non-farm activities		
		6. Water harvesting		
		7. Planting trees		
		8. Increased use of irrigation		
		9. Increased use of fertilizer		
47	When do you take adaptation actions?	1. When faced with problems of climate variability 2. With the anticipation of problems of climate variability 3. When informed by others (like DAs, or elders) 4. Others (specify) _____		
48	What do you think are the constraints affecting adaptation to climate variability?	1. Lack of access to finance 2. Lack of access to modern inputs 3. Lack of information 4. Lack of technical support 5. Shortage of land 6. Lack of water 7. Shortage of labor 8. Lack of market access 9. Insecure land tenure		

V. Issues concerning food insecurity situation

49. What are the sources of food for your household?

1. Own production and/or livestock raising
2. Purchase of food items from the market
3. Borrowing food or support from relatives
4. Food aid by government or NGO
5. Others (specify)_____

50. If you are producing what you consume, for how many months you consume your own produce?

1. 1-3 months 2. 4-6 months 3. 7-9 months 4. 10-12 months

51. If your produce is not adequate for the whole year, how do you fill the gap?

1. Food aid
2. Borrowing
3. Engage in food for work
4. Engage in casual labour
5. Income from off-farm activities
6. Remittance
7. Others (specify) _____

52. Identification of reasons for food insecurity:

S.No.	Causal factors	Problems encountered
1	In relation to **environmental** factors, what are the problems you frequently faced?	1. Drought 4. Diseases and pests 2. Erratic rain 5. Weeds 3. Soil erosion 6. Poor soil fertility
2	In relation to **demographic** factors, what are the problems you have faced?	1. Diminishing landholding size 2. Farmland fragmentation 3. Lack of fallow land 4. Overgrazing
3	In relation to **economic** factors, what are the constraints not to solve your food insecurity?	1. Lack of cash 2. Absence of off-farm income 3. Shortage of farm oxen 4. Low modern farm inputs 5. Traditional farming implements and practices
4	With respect to **physical** infrastructure, what are the constraints not to solve your food insecurity?	1. Lack of road transport 2. Lack of irrigation access 3. Lack of credit 4. Lack of extension service 5. Use of traditional storage facilities 6. Lower cost of agricultural outputs 7. Lack of veterinary services
5	With regards to **social** factors, what are the constraints not to solve your food insecurity?	1. Lack of human labor 2. Sickness of household members 3. Lack of education 4. Lack of food aid 5. Lack of saving culture

53. How do you cope with problem of food shortage?

S.No	Coping strategy	Whether you use the strategy or not: 1. Yes 2. No	When do you use the strategy: 1. Less severe 2. Moderately severe 3. Severe
1	Skipping one or two meals per day		
2	Reduction in quality and quantity of food consumed		
3	Engaging on off-farm activities		
4	Consuming less preferred foods		
5	Borrow grains from relatives		
6	Borrow grain or cash from money lenders		
7	Sell off small animals		
8	Firewood and charcoal selling		
9	Rely on relief grains		
10	Reducing the number of people eating in the household		
11	Sell of farm oxen		
12	Lease out land		
13	Sell of land		
14	Distress migration		

54. Do you have access to safe drinking water? 1. Yes 2. No

55. If your answer is **yes**, what are the sources?

1. Protected spring 2. Protected well 3.Tap water 4. Other (specify) _____

56. If your answer is **No** to Q55, where do you get water for different purposes?

1. River/Stream
2. Unprotected pond
3. Direct rain water harvesting
4. Unprotected spring
5. Floods in gully
6. Others (specify) _____

57. Do you have your own latrine? 1. Yes 2. No

58. If your answer is **No**, where do you defecate? 1. Open field 2. In the forest/bushes

59. Where do you dispose waste? 1. Open field 2. In the garden 3. In a waste disposal pit

60. How many times in a day do you wash your hand? _____

61. When are those times that you wash your hands?

1. _____ 3. _____
2. _____ 4. _____

62. Measurement of food insecurity through HFIAS

S.no	Questions	Responses categories	Code
1	In the past four weeks, did you worry that your household would not have enough food?	0 = No (Skip to Q2) 1 = Yes	
1a	How often did this happen?	1=Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
2	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	0 = No (Skip to Q3) 1 = Yes	
2a	How often did this happen?	1= Rarely 2 = Sometimes 3 = Often	
3	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0 = No (skip to Q4) 1 = Yes	
3a	How often did this happen?	1= Rarely 2 = Sometimes 3 = Often	
4	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	0 = No (Skip to Q5) 1 = Yes	
4a	How often did this happen?	1= Rarely 2 = Sometimes 3 = Often	
5	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0 = No (Skip to Q6) 1 = Yes	
5a	How often did this happen?	1= Rarely 2 = Sometimes 3 = Often	
6	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	0 = No (Skip to Q7) 1 = Yes	
6a	How often did this happen?	1= Rarely 2 = Sometimes 3 = Often	
7	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?	0 = No (Skip to Q8) 1 = Yes	
7a	How often did this happen?	1= Rarely 2 = Sometimes 3 = Often	

8	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	0 = No (Skip to Q9) 1 = Yes	
8a	How often did this happen?	1= Rarely 2 = Sometimes 3 = Often	
9	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	0 = No 1 = Yes	
9a	How often did this happen?	1= Rarely 2 = Sometimes 3 = Often	

63. Measurement of food insecurity through **Household Dietary Diversity Score**

Did you or anyone in the household ate or drink the following food group in the last 24 hours?

S.No.	Food groups	Response category 1. Yes 2. No
1	Cereals (Injera, bread, kitta, porridge, etc.)	
2	Roots and tubers (potato, onion, sweet potato, beet root, cassava)	
3	Vegetables (pumpkin, carrots, green paper, cabbage, lettuce, tomato)	
4	Fruits (mangoes, orange, banana, lemon, Zeyituna, papaya)	
5	Meat, poultry and offal (beef, chicken, goat, lamb)	
6	Eggs (eggs)	
7	Fish (fresh and dried fish)	
8	Pulses/Legumes/Nuts (beans, peas, lentils, chick peas or foods made from them)	
9	Milk and milk products (milk, cheese, yoghurt, etc.)	
10	Oil/Fats (oil, fats or butter added to food)	
11	Sweets (sugar, honey, sweetened soda or sugary foods such as chocolates, candies, etc.)	
12	Spices, condiments, beverages (spices like back pepper, salt; condiments like soy sauce, hot sauce; coffee, tea, alcoholic beverages, etc)	

VI. Vulnerability situation: exposure, sensitivity and adaptive capacity

S.No.	**Questions on vulnerability components**	**Response categories**
	Exposure	
64	Do you think that the temperature of your locality has increased over the last 5-10 years?	1. Yes 2. No
65	Have you observed that the rainfall of your main season starts late and ends early?	1. Yes 2. No
66	Do you think that the rainfall is adequate for crop and animal production?	1. Yes 2. No

67	What do you think about the intensity of rainfall pattern?	1. Normal 2. Extreme (Heavy) 3. Irregular (unpredictable)
	Sensitivity	
68	Which months of the year do you face serious food shortage?	_____ to _____ months
69	Have you ever engaged in conflict due to competition on resources like grazing land, construction materials (sand), etc?	1. Yes 2. No
70	What are the human health problems that have resulted due to climate variability?	1. _____ 2. _____ 3. _____
71	What are the animal health problems you faced due to climate variability?	1. _____ 2. _____ 3. _____
72	In which months of the year do you encounter serious water scarcity? A) For humans B) For animals	A1. _____ B1. _____
	Adaptive capacity	
73	Do you feel that your land holding is adequate to support your whole family?	1. Yes 2. No
74	Do you have the necessary equipments for farming?	1. Yes 2. No
75	Is there any arrangement in your *kebele* that provides assistance when faced with food shortage?	1. Yes 2. No
76	If your answer is **yes**, what kind of services do you get?	1. Cash assistance 2. Credit/Loan service 3. Food aid 4. Others (specify) _____
77	Do you have access to veterinary services	1. Yes 2. No
78	Which technological options do you use to improve your productivity and overcome food insecurity and/or problems of climate variability?	1. Use of irrigation 2. Use of Water harvesting 3. Use of drought resistant seeds 4. Use high yielding varieties for both crop and animals 5. Increased use of fertilizer 6. Others (specify) _____

VII. Roles of institutions in curbing problems of climate variability and food insecurity

79. Do you think that women have equal rights with men in terms of getting access to land for farming and other resources? 1. Yes 2. No
80. If your answer is **No**, what do you think are the constraints?
    1. Existence of traditions that prohibit women not to have equal access
    2. Government policy being discriminatory
    3. Lack of awareness/Illiteracy
    4. Others, please specify _____
81. Do you have access to the services of development agents? 1. Yes 2. No

82. If your answer is **yes**, what kind of services do you get?
    1. Training on new techniques of farming
    2. Information on climate variables
    3. Advice on different agricultural practices
    4. Facilitating access for modern inputs
    5. Others, please specify _____
83. If your answer is **No** to Q82, what do you think is the reason?
    1. Discrimination
    2. Lack of commitment by the DAs
    3. Not interested in getting their services
    4. Others (specify) _____
84. Do you have access to the services of health extension workers? 1. Yes 2. No
85. If your answer is **Yes**, what kind of services do you get?
    1. Advice on hygiene and sanitation
    2. Advice on food preparation and feeding practices
    3. Information on climate variables
    4. Others (specify) _____
86. Do you have access to credit services whenever you require it? 1. Yes 2. No
87. If your answer is **Yes** to Q86, what are the sources of your credit access?
    1. Individual money lenders 4. Government organization
    2. Credit associations 5. A combination of these _____
    3. Relatives/Friends
88. For what purpose do you use the money that you borrowed?
    1. Purchase of modern inputs 4. Purchase of livestock
    2. Purchase of materials for children 5. Others (specify) _____
    3. Purchase of food
89. What is the distance between your house and the nearest input/output market in hours? ____
90. What is the distance between your house and the nearest road to take transport in hours? ___
91. What is the distance between your house and the nearest health service facility in hours? __
92. In which of the social organizations do you belong?
    1. Idir 2. Iqub 3. Jigi/Debo/Wonfel 4. Mahiber
    5. Producer's association 6. Other (specify) _____
93. What are the services provided by the social organizations you belong?
    1. _____ 3. _____
    2. _____ 4. _____
94. What are the bases to be member of these social organizations?
    1. _____ 2. _____ 3. _____
95. Besides government, are there other organizations who support you to overcome impacts of climate variability and/or food insecurity? 1. Yes 2. No
96. If your answer is **Yes**, what kind of support you obtain from them?
    1. _____ 3. _____
    2. _____ 4. _____

97. If your answer is **Yes** to Q95, how do you evaluate the support you are obtaining?
    1. Adequate 2. Not adequate 3. Discriminatory/Selective
98. If your answer is **not adequate**, what do you think should be added?
    1. _____
    2. _____
    3. _____

Appendix II. Interview Guideline for Boset District Agency for Animal Production

1. How do you perceive about the existing climate?
2. What was the trend of the climate variability overtime?
3. What do you think are the consequences could be?
4. What do you think are the biggest challenges in the District?
5. What do you think are the opportunities to improve the livelihood of the rural households?
6. What are the major areas your Agency is engaged in?
7. What are the strategies you used to implement your activities?
8. What are the problems you encountered in relation to animal husbandry?
9. What do you recommend to improve the overall situation?

Appendix III. Interview Guideline for Boset Distinct Office of Agricultural Development (Natural Resources Management Team Process Owner)

1. How do you perceive about the existing climate?
2. What do you think is the relationship between climate variability and food insecurity?
3. What has happened to the natural resources of the District? If there are changes, what do you think are the triggering factors?
4. What did the rural households been doing to adapt to the changing environment?
5. What are the major areas your specific team is engaged in?
6. What are the major strategies you employed to implement your major activities?
7. What are the major challenges you have been faced with?
8. What do you think are the opportunities available to improve the overall livelihood situation of the rural households?
9. What do you recommend so that your performance could be enhanced?

Appendix IV. Interview Guideline for Boset District Office of Disaster Prevention and Preparedness

1. How do you perceive the existing climate variability?
2. What does the trend of the climate variability looks like?
3. What do you think is the relationship between the existing climate variability and food insecurity in the district?
4. What did the rural households been doing to adapt to the changing environment?
5. What are the major tasks your office is engaged in?
6. What are the strategies you employ to implement the major tasks?

7. What are the biggest challenges in the district that constrain the livelihood of the rural households?
8. What are the opportunities that exist within the district to improve the livelihood of the rural households?
9. What do you recommend to improve your office's performance and improve the overall livelihood situation of the people?

Appendix V. Interview Guideline for Boset District Water Resources Office

1. How do you perceive the existing climate variability? How can it be expressed?
2. What do you think are the consequences of climate variability?
3. Do you think that there is adequate water (both for people are animals) in the district? if your answer is no, what do you think are the reasons behind?
4. How much is the water coverage of the district? What types of schemes do exist in the *kebeles*? What are the statuses of the schemes?
5. What are the major tasks you are engaged in as an office?
6. What are the strategies you employ to accomplish the major tasks?
7. What are the major challenges in the district that constrain your accomplishment?
8. What do you recommend so that the whole rural households' livelihood could be improved?

Appendix VI. Interview Guideline for Boset District Women and Children Affairs Office

1. How do you perceive the existing climate variability?
2. What do you think are the consequences of unprecedented climate variability?
3. How do you think climate variability and food insecurity are related?
4. What do you think are the major causes of food insecurity in the district?
5. What do you think are the specific problems women could encounter as a result of climate variability and food insecurity?
6. In relation to culture, what are the specific problems women in the district are faced with?
7. What are the major tasks your office is undertaking?
8. What are the challenges you encountered in implementing the major tasks?
9. What are the strategies you have been employing to implement the major tasks of the office?
10. What do you recommend to improve the existing women's situation and improve the overall situation of rural households in the district?

Appendix VII. Interview Guideline for Boset District Agricultural Development Office (ExtensionSection Team Process Owner)

1. What are the major extension packages your office is implementing?
2. What are the other works you undertake other than the extension packages?
3. What has happened to the landholdings of the rural households?
4. How can the production and productivity of households expressed in the district?
5. How doesthe soil degradation in the district could be expressed?
6. What does the availability and use of modern inputs in the district look like?

7. What are the main challenges of productivity at the district level?
8. What are the new technologies introduced to the rural households?
9. What is the adoption status of these technologies and what are the challenges in the process?
10. What does the use and management of farm products of the rural households look like?
11. Are there any benefits earned from the provision of landholding certificate?
12. What are the constraints for livelihood diversification of the rural households?
13. How do you perceive the work ethic and saving culture of the rural households?
14. For how months of the year do
15. How do you think that food insecurity is resulted?
16. How do you think that climate variability could be expressed? Does it change across time?
17. What are the adaptation strategies that the rural households are employing? What are the activities being done by your office?
18. What are the local institutions found in the rural parts of the district? What are the services the local institutions are giving?
19. What has happened to the local institutions and the services they are providing overtime?
20. In relation to culture, what are the practices that constrain the livelihoods of the rural population? What are you doing to avert such situations?
21. What sort of relationship do you have with NGOs working in the district? do you think that the services they provide are adequate?
22. Who are more exposed to food insecurity and/or climate variability?
23. What are the sources of weather/climate information for the rural population at large?
24. What do you think that should be done to improve the livelihoods of the rural population in general?

Appendix VIII. Interview Guideline for Boset District Health Office

1. How do you perceive the food insecurity situation of the district?
2. What do you think are the causes of food insecurity in the district?
3. How do you perceive about the relation between the current climate variability and food insecurity in the district?
4. What are the major activities your office is engaged in to alleviate food insecurity?
5. What does the situation of Water Supply, Sanitation and Hygiene practices look like?
6. What are the roles that the health extension workers are playing?
7. What do you think are the major challenges that constrain the achievement of food security?
8. What is your suggestion to impove the overall livelihood situation of the rural people in the distict?

Appendix IX. Interview Guideline for Boset District Irrigation Development Office

1. What do you think about the climate variability situation in the district?
2. What are the indicators to say the climate is changing?
3. What do you think are the causes and consequences of climate variability?

4. What did the rural households been doing to adapt to the changing environment?
5. What are the major tasks your office is engaged in?
6. What the strategies you employ to undertake the major tasks?
7. What do you think are the problems that constrain households not to adapt as their wish?
8. Which *kebeles* have access to irrigation facilities?
9. Do you think that the existing irrigation access could be expanded? If not, what are the major constraints?
10. How do you think that irrigation access could help in reducing food insecurity?
11. What are the contributions of irrigation facilities towards reducing food insecurity?
12. What do you recommend so that livelihoods of the rural households could be improved?

Appendix X. Interview Guideline for World Vision Ethiopia Boset Area Development Program (Food Security Focal Person)

1. When did the organization started to operate in the district?
2. What are the major areas/themes your organization is operating on?
3. What are the major tasks you are undertaking as a team?
4. Specific to food insecurity, what do you think are the major causes of food insecurity?
5. What do you find as the coping strategies of the households used to overcome food insecurity?
6. How do you evaluate the coping capacity of households or ability to recover from shocks?
7. Which segment of the society do you think are more exposed to food insecurity? Why do you think this is the case?
8. In relation to food insecurity, what are the specific things you are doing to help households overcome this problem?
9. What are the biggest challenges for the households that constrain not to overcome food insecurity?
10. How do you evaluate the future prospect of the households in terms of getting rid of food insecurity?
11. What are the inclusion criteria of households in your program (specifically with reference to food insecurity)?
12. What kind of traditional practices, that you observed, have contributed for the food insecurity of households?
13. What are the problems/constraints you encountered while implementing the food security program?
14. How do you see the food security situation of the district overtime?
15. How do you see gender and food insecurity in the district?
16. How do you evaluate the role of different actors (like research centers, government bodies, and the community themselves) in alleviating food insecurity?
17. How do you see the four components of food (in)security with respect to your operating area?
18. How do you see the relationship between climate variability and food insecurity?
19. What do you think are the risks that community members are confronted with?
20. What are your suggestions so that the rural householdscan get out of their current situation and improve their livelihoods?

Appendix XI. Interview Guideline for Community Elders in Boset District

1. How do you perceive the existing climate variability? Is there any change?
2. If yes, what do think are the major causes for the change?

3. What are the strategies households use to overcome the challenges of climate variability?
4. How do you think that climate variability and food insecurity are related?
5. What are the months of the year that households face serious food shortage?
6. What do households do to overcome such serious food shortages?
7. What are the problems in relation to animal husbandry?
8. What has happened to the land holding and productivity?
9. What are the local institutions you use to overcome problems encountered by households?
10. What do you think should be done to improve the overall livelihood situation of the rural households?

Appendix XII. Interview Guideline for Focus Group Discussions of households in different *kebeles* of Boset District (for both Male and Female headed households)

1. Do you think that the climate is changing in unusual way?
2. If yes, what do you think are causes and consequences of climate variability?
3. What are the adaptation strategies households use to overcome problems emanating from climate variability?
4. Do you think climate variability and food insecurity are related? If yes, How?
5. What kind of households are most food insecure?
6. Which months of the year do households face serious food shortage?
7. What are the strategies households employ to overcome the food shortage they encounter?
8. What are the main problems that constrain households in their attempt to overcome food insecurity?
9. What are the main sources of information about the surrounding climate?
10. What has happened to the landholding and productivity?
11. How do you evaluate the support households are getting from NGOs working in your area?
12. What kinds of local institutions exist which help to overcome food insecurity?
13. What are your suggestions to improve the overall livelihoods of the rural households?

Appendix XIII: **Correlation matrix to test multicollinearity**

```
. correlate gender age educ nmemb nonfarm landsize yrfarming irrland totincm wthrforcast DAservice crdtserv distmkt
(obs=397)
```

	gender	age	educ	nmemb	nonfarm	landsize	yrfarm~g	irrland	totincm	wthrfo~t	DAserv~e	crdtserv	distmkt
gender	1.0000												
age	-0.0311	1.0000											
educ	0.0878	-0.2441	1.0000										
nmemb	0.1296	0.3346	-0.0241	1.0000									
nonfarm	-0.1239	-0.0223	-0.0986	-0.0075	1.0000								
landsize	-0.1784	0.2402	-0.1662	0.0577	-0.0460	1.0000							
yrfarming	-0.0477	0.8727	-0.1709	0.3730	-0.0354	0.2704	1.0000						
irrland	0.1159	0.0831	0.0981	0.0877	-0.1058	-0.0749	0.0644	1.0000					
totincm	0.1548	0.0552	0.0644	0.2593	0.1326	0.0651	0.0496	0.2706	1.0000				
wthrforcast	0.0003	0.0714	0.0030	0.1322	-0.0003	0.1256	0.0480	0.0204	0.0385	1.0000			
DAservice	0.0111	-0.0413	-0.0790	0.0601	0.0494	0.0006	-0.0021	0.0018	0.0718	0.0578	1.0000		
crdtserv	-0.1109	0.2159	-0.1551	-0.0016	0.1105	0.3160	0.2258	-0.0418	0.0425	-0.0140	-0.0422	1.0000	
distmkt	0.0241	0.0765	-0.0036	0.1615	-0.1961	0.1436	0.0382	0.0093	-0.0366	0.1728	0.0572	-0.0267	1.0000

Value of VIF after dropping yrfarming as predictor variable.

Collinearity test

```
. collin gender educ2 age nmemb landsize totincm wthrforcast DAservice crdtserv distmkt
(obs=397)

  Collinearity Diagnostics

                      SQRT                   R-
  Variable      VIF     VIF    Tolerance    Squared
----------------------------------------------------
    gender      1.08    1.04    0.9224      0.0776
     educ2      1.20    1.10    0.8302      0.1698
       age      1.41    1.19    0.7090      0.2910
     nmemb      1.28    1.13    0.7786      0.2214
  landsize      1.24    1.11    0.8089      0.1911
   totincm      1.12    1.06    0.8938      0.1062
wthrforcast      1.07    1.03    0.9353      0.0647
 DAservice      1.02    1.01    0.9830      0.0170
  crdtserv      1.16    1.08    0.8605      0.1395
   distmkt      1.10    1.05    0.9108      0.0892
----------------------------------------------------
  Mean VIF      1.17
```