

RESILIENCE OF RURAL HOUSEHOLDS TO FOOD
INSECURITY IN AHFEROM WEREDA, CENTRAL ZONE OF
TIGRAY NATIONAL REGIONAL STATE, ETHIOPIA

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DECLARATION

I, the undersigned, declare that this dissertation is my original research work and has never been submitted for any academic study in any other university for award of any type of academic degree. All sources of materials used for this work have been duly acknowledged.

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ABSTRACT

Food security analysis has concentrated in and limited to estimation of vulnerability of households to food insecurity and calculations of food deficits. This focus on vulnerability of households to food insecurity has led to aid dependent food security strategy and proliferation of development agencies providing humanitarian aid. The humanitarian experiences and food aid provisions to Ethiopia alone proves the failure of the vulnerability literature and its food aid policy version to empower food aid recipients. This conceptual gap enabled scholars to introduce the concept of resilience to food security literature. This dissertation intends to study resilience of rural households to food insecurity. It examines livelihood asset endowments of households and their multidimensional food security status as well as their resilience capacity to adverse livelihood outcomes. The study adopts sustainable livelihood and resilience integrated framework. The integrated framework emphasizes the necessity of resilience capacity of households which heavily relies on their access to and control over livelihood assets mediated by conversion factors to pursue certain livelihood strategies to reduce food insecurity. Cross-sectional survey study was conducted in six proportionately selected *Kebeles* of Ahferom Wereda, Central Zone of Tigray National Regional State. The primary data were gathered from systematically selected 400 rural households using pre-tested semi-structured questionnaire. Descriptive and multivariate techniques were employed to analyze the quantitative data. Qualitative data were also used to substantiate and support the quantitative data findings.

The livelihood asset endowments of households were estimated using asset index. Asset indices close to zero imply low asset endowment while index scores close to one imply high asset endowment of households. The aggregate asset endowment analysis revealed that the households, on average, had 0.127 asset stock. This small asset stock indicates that the households are vulnerable to multitude of natural and manmade shock factors and undesirable livelihood outcomes. The disaggregate livelihood asset endowment analysis reveals that human capital and social assets are relatively abundant in the study area. Financial capital is the least readily available livelihood asset in the area. The study revealed that the credit households borrowed from formal and informal institutions is ineffective to reduce food insecurity of households due to inappropriate usage and high interest rate in the area. It explicitly calls for the introduction of financial asset package, and tight monitoring and follow up mechanisms. The analysis further calls for broad-based infrastructure development, rural electrification, alternative energy supply as well as secondary and preparatory school expansion.

The multidimensional food security analysis reveals that none of the households in the area are multi-dimensionally food secure. This complete absence of multi-dimensionally food secure households in the area portrays that the existing structures and processes are not enabling them to convert the livelihood resources they are endowed with into desirable [food secure] livelihood outcomes. The study found out that almost all of the studied households were multi-dimensionally [mildly] food insecure in the survey time. This high mild food insecurity prevalence demonstrates that a small deviation in reduced agricultural production and reduction in the long-term productive safety-net program could push a significant percentage of households into moderate or severe food insecurity condition. The finding of multidimensional food security analysis calls for modernization of agricultural input supply system, institutional restructuring and agricultural technology generation and innovation to transform the smallholder agriculture and revolve the overall economy.

Resilience of households to food insecurity here refers to the ability of those households to maintain certain level of food security in the shock-prone area. It is a latent variable made up of multiple indicators (or components). The aggregate resilience capacity analysis indicates that half of the sampled households were resilient while the rest were less resilient. The separate analysis of resilience dimensions reveals that social capital and adaptive capacity are relatively abundant in the area. They have conversely limited access to basic services and foods. It also confirmed that gender disparity undermines resilience capacity of households where male headed households were more resilient than their counterparts. This is backed up by the descriptive analysis that indicates half of the multidimensionality food insecure households were resilient to food insecurity. The analysis indicates that the resilience capacity of households decreases with increasing food insecurity measured by HFIAS. Similarly, over half of the multi-dimensionally (mildly) food insecure households have high resilient capacity. The study infers that food insecure households are not necessarily fragile. This implies that food security studies without due resilience capacity analysis do not provide the true picture of livelihood condition of households.

Key Words: Rural Livelihoods, Composite Asset Index, Multidimensional Food Security, Multiple Correspondence Analyses, Shock, Principal Component Analysis, Resilience, Adaptive Capacity, Absorptive Capacity, Transformative Capacity

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	v
ABSTRACT	vi
LIST OF TABLES	xi
ACRONYMS	xii
1. INTRODUCTION	1
1.1. Background of the Study	1
1.2. Statement of the Problem	3
1.3. Research Questions	8
1.4. Research Objectives	8
1.5. Scope and Delimitation of the Study	9
1.6. Significance of the Study	10
1.7. Structure of the Dissertation	11
2. LITERATURE REVIEW	12
2.1. Theoretical Literature	12
2.1.1. Introduction	12
2.2. Development Theories Underpinning Food Security	14
2.2.1. Modernization and Dependency Perspectives on Food Security	15
2.2.2. Postmodern Perspective on Food Security	19
2.3. Theoretical and Conceptual Approaches to Food Security	23
2.3.1. Concepts and Indicators of Food Security	23
2.3.2. Food Availability Decline (FAD)	24
2.3.3. Food Entitlement Decline (FED)	26
2.3.4. Political Economy Approach (PEA)	28
2.4. Sustainable Livelihood Approach (SLA)	30
2.4.1. Livelihood Resources (Assets)	32
2.4.2. Vulnerability Context	33
2.4.3. Transforming Structures and Processes	34
2.4.4. Livelihood Strategies	34
2.4.5. Livelihood Outcomes	35
2.5. Resilience of Households to Food Insecurity	36
2.5.1. Principles of Resilience Measurement	37
2.6. Empirical Literature	39

2.7.	Conceptual Framework of the Study	43
3.	METHODOLOGY	46
3.1.	Description of the study area	46
3.2.	Research Design	48
3.2.1.	Research Philosophy	48
3.2.2.	Data Type and Source	51
3.2.3.	Data Collection Methods and Tools	51
3.2.3.1.	Questionnaire	52
3.2.3.2.	Focus Group Discussion (FGD)	52
3.2.3.3.	Key Informant Interview (KII)	52
3.2.4.	Sampling and Sample Size Determination	53
3.2.4.	Data Analysis	56
4.	RURAL LIVELIHOOD ASSET ENDOWMENTS ANALAYSIS	57
4.1.	Introduction	57
4.2.	Weighting Methods	59
4.2.1.	Multiple Correspondence Analysis	60
4.3.	Livelihood Asset endowments Analysis	63
4.3.1.	Natural Asset Endowment Analysis	63
4.2.2.	Human Asset Endowment Analysis	70
4.2.3.	Physical Asset Endowment Analysis	77
4.2.4.	Social Asset Endowment Analysis	81
4.2.5.	Financial Asset Endowment Analysis	87
4.2.6.	Livelihood Asset Pentagon	90
4.3.	Chapter Summary	92
5.	MULTIDIMENSIONAL FOOD SECURITY ANALYSIS	94
5.1.	Introduction	94
5.2.	Food Security Dimensions	94
5.3.	Selection of Food Security Indicators and Metrics	97
5.3.1.	National Food Security Indicators	98
5.3.2.	Household Food Security Indicators	99
5.3.2.1.	Household Dietary Diversity Score (HDDS)	101
5.3.2.2.	Food Consumption Score (FCS)	102
5.3.2.3.	Household Food Insecurity Access Scale (HFIAS) and HHS	103

5.3.2.4.	Coping Strategy Index (CSI).....	104
5.4.	Multidimensional Food Security Indicator (MFI)	106
5.4.1.	The Concept of MFI	106
5.4.2.	Multidimensional Food Security Indicator Tabulation	108
5.4.3.	Multidimensional Household Food Security Status	109
5.4.4.	Multidimensional Food Security Decomposition	113
5.5.	Household Food Insecurity Access Scale (HFIAS).....	115
5.6.	Multidimensional Food Security and HFIAS Comparative Analysis	119
5.7.	Chapter Summary	120
6.	RESILIENCE OF HOUSEHOLDS TO FOOD INSECURITY	121
6.1.	Introduction	121
6.2.	Resilience Capacity Indicators	121
6.3.	Weighting Method	124
6.4.	Shock Exposure	128
6.5.	Resilience Capacity Analysis	134
6.5.1.	Food Access Index (FAI)	134
6.5.2.	Access to Basic Services (ABS)	137
6.5.3.	Agricultural Assets (AA).....	141
6.4.4.	Social Capital (Social Safety-Nets-SSN)	145
6.4.5.	Livelihood Stability.....	147
6.4.6.	Adaptive Capacity (AC).....	150
6.4.7.	Absorptive Capacity (ABC)	155
6.4.8.	Transformative Capacity (TC).....	157
6.5.	Resilience Capacity Decomposition	161
6.6.	Chapter Summary	163
7.	CONCLUDING REMARKS AND POLICY RECOMMENDATIONS	166
7.1.	Empirical Conclusion	166
7.2.	Policy Recommendations.....	171
7.3.	Future Research Areas	173
	REFERENCES.....	174
	APPENDICES	185

LIST OF TABLES

Table 1: Summary of empirical works on resilience of households to food insecurity	42
Table 2: Sample <i>Kebeles</i> and households	55
Table 3: Natural asset stock multiple correspondence analysis coefficients.....	70
Table 4: Human asset stock multiple correspondence analysis coefficients.....	76
Table 5: Multiple correspondence analysis invariable physical asset variables.....	79
Table 6: MCA monotonicity test of physical asset variables.....	80
Table 7: Physical asset stock multiple correspondence analysis coefficients	81
Table 8: Social asset stock multiple correspondence analysis coefficients	86
Table 9: Financial asset stock multiple correspondence analysis coefficients.....	90
Table 10: Summary of food security indicators	105
Table 11: Multidimensional food security indicator category scheme	108
Table 12: Multidimensional food security status of households	112
Table 13: Multidimensional food security indicators decomposition	113
Table 14: Household Food Insecurity Access Scale Scheme (HFIAS).....	116
Table 15: Household Food Insecurity Access Scale (HFIAS) Score	118
Table 16: Multidimensional food security and HFIAS comparative analysis	119
Table 17: Percent of households experienced various shocks in the last year	132
Table 18: Shock exposure and ability of households to recover from shocks	134
Table 19: Mean Values and Weights of Food Access indicators and variables (n=400)	137
Table 20: Mean values and loading factors (weights) of access to basic services variables (n=400)	141
Table 21: Mean values and loading factors of agricultural asset index indicators and variables.....	144
Table 22: Mean values and loading factors of social capital indicators and variables (n=400).....	147
Table 23: Mean values and weights of livelihood stability indicators and variables (n=400).....	149
Table 24: Mean values and loading factors of adaptive capacity indicators and variables (n=400)	155
Table 25: Mean values and loading factors of absorptive capacity indicators and variables (n=400)	157
Table 26: Mean values and loading factors (weights) of transformative capacity variables (n=400)	160
Table 27: Resilience indicators score and resilience mean values	161
Table 28: Resilience Capacity Decomposition	163

LIST OF FIGURES

Figure 1: Sustainable Livelihood Framework.....	35
Figure 2: Conceptual Framework of the Study	45
Figure 3: Ahferom Wereda Administration Map	47
Figure 4: Livelihood Asset Pentagon	91
Figure 5: Path diagram resilience model of households to food insecurity	123

ACRONYMS

ADLI	Agricultural Development Led Industrialization
AGRA	Alliance for a Green Revolution in Africa
CHE	Complex Humanitarian Emergencies
CSI	Coping Strategy Index
DFID	Department for International Development, the Government of United Kingdom
ETB	Ethiopian Birr
EU	European Union
DAs	Development Agents
FAD	Food Availability Decline
FSS	Food Security Strategy
FSP	Food Security Program
FAO	Food and Agriculture Organization of the United Nations
FCS	Food Consumption Score
FDI	Foreign Direct Investment
FED	Food Entitlement Decline
GTPI	Growth and Transformation Plan I
GTPII	Growth and Transformation Plan II
GHI	Global Hunger Index
GDP	Growth Domestic Product
HDDS	Household Dietary Diversity Scale
HFIAS	Household Food Insecurity and Access Scale
HHS	Household Hunger Scale
HSQ	Household Survey Questionnaire
IFPRI	International Food Policy Research Institute
ISI	Import Substitution Industrialization
MCA	Multiple Correspondence Analysis
MDGs	Millennium Development Goals
masl	Meters above sea level
MFI	Multidimensional Food Security Indicator
MNCs	Multinational Corporations
MOARD	Ministry of Agriculture and Rural Development
MOFED	Ministry of Finance and Economic Development
PADETES	Participatory Demonstration and Training Extension System
PASDEP	Plan to Accelerated and Sustained Development to End Poverty
PEA	Political Economy Approach
PCA	Principal Correspondence Analysis
PSNP	Productive Safety Net Program
RAU	Resilience Analysis Unit of FAO
rCSI	Reduced Coping Strategies Index
SDPRP	Sustainable Development and Poverty Reduction Program
SAFS	Self-assessed Measure of Food Security
SDGs	Sustainable Development Goals
SLA	Sustainable Livelihood Approach
TLU	Tropical Livestock Unit
UNDP	United Nations Development Program
UNECLA	United Nations Economic Communion for Latin America
USA	United States of America
USD	United States Dollar
USAID	United States of America International Agency for Development
WFP	World Food Program
WFS	World Food Summit

1. INTRODUCTION

1.1. Background of the Study

Food insecurity degrades human dignity. In fact, the United Nations has declared that everyone has the right to food (UN, 2015). The last decade of the 20th century was remarked by a global commitment to drastically reduce hunger. The world leaders had made a firm commitment to halve the proportion of people who suffer from extreme poverty and hunger no later than 2015 (WFS, 1996; MDGs, 2000). Possibly, the prevalence of poverty and food insecurity has globally been declining in the last two decades. Yet, about 800 million people were considered food insecure in 2014 (FAO, IFAD and WFP, 2015). The large majority of these food insecure people are geographically concentrated in Asia and Africa where Southern Asia (35.4 percent), Sub-Saharan Africa (27.7 percent) and Eastern Asia (18.3 percent) constituted over 81 percent of the world poor and food insecure people. Contrary to the global trend, poverty and food insecurity in Sub-Saharan Africa has been increasing since 1990s. The total number of food insecure people grew from an estimated 175.7 million people in 1990s to 220 million people in 2014 in Sub-Sahara Africa. Nearly one in every four people in the region is food insecure (FAO, IFAD and WFP, 2015) indicating that the region had failed to meet the international poverty reduction commitments and food security declarations. Subsequently, the world leaders have announced the SDGs on 1 January 2016 which will guide the decisions the international community make over the next fifteen years. The SDGs builds on the MDGs and seeks to complete what the latter failed to meet. The leaders reaffirmed to ending poverty, food insecurity and hunger in all their forms and dimensions everywhere by 2030 (UN, 2015). It is, however, too early to predict the impact of the SDGs on the region in the next fifteen years.

Ethiopia is the land of controversy. It is the second most populous country in Africa. The country has a long history, with a mosaic of peoples and diverse cultures. It has tremendous potential for development. It has sizable agricultural land that can support its increasing population, immense biodiversity, adequate water resources and minerals, and large number of working age population (MOFED, 2002). Paradoxically, the country is one of the poorest countries in the Sub-Sahara African region with low level of development indicators. It has been suffering from complex and structural poverty and painful food insecurity (MOFED, 2002). Recurrent drought induced food insecurity has frequently hit Ethiopia. Degefa (2005)

reviewed that the country has experienced 44 severe famine catastrophes over its history. Such severe food insecurity incidences are still hitting the country.

Most famines and food crisis in Ethiopia have geographically been concentrated in two famine-prone regions. The first famine-prone region of the country comprises the Central and Northern highlands of the country stretching from Northern Shewa through Wello and Tigray which are predominately inhabited by smallholder sedentary mixed farmers. The second famine-prone area is made up of a crescent of low-lying agro-pastoral lands of the eastern and the southern extension of the highlands covering some parts of North Shewa, East Hararghe, Borana and Bale of Oromia, Sidamo and Gamo Gofa zones of the south, and Afar and Somali regions (Degefa, 2005:2-3).

The historical experiences of the developed countries demonstrate that agricultural development precedes industrial development. This agriculture first doctrine assumes that agricultural sector leads the entire economy and the development of other economic sectors hinges upon the achievements in the agricultural sector (Getnet, 2003). The persistent food insecurity in Ethiopia has partly been attributed to the absence of appropriate policies and strategies. The public policies and strategies have long been urban biased and failed to address rural poverty and food insecurity. This was evident during the subsequent Imperial and Dergue regimes where the development strategy of the country was based on Import Substitution Industrialization (ISI) that accords primacy to industry (Getnet and Malek, 2010; Dorosh et al., 2011). These urban biased ISI development strategies of the regimes (Getnet and Malek, 2010; Dorosh et al., 2011) were in contradiction with the strong evidence that agricultural growth has a high poverty reduction pay-off (World Bank, 2007). The failure to transform the sector specifically attributed to biophysical factors (environmental degradation, recurrent drought and widespread epidemics), socio-economic constraints (poor infrastructure development, market imperfection, long lasting civil wars, traditional cultural values and norms) and institutional factors (such as policy failures, low level of technology generation and adoption (technological stagnation) and inflexible land tenure system) limiting the production and productivity of agriculture and overall development (see Belay, 2003; Degefa, 2005; IFPRI, 2010; Tagel and Veen, 2010).

Agricultural growth underpins income of the poor (World Bank, 2007; IFAD, 2013). African poor population has been unable to move out of poverty because of their failure to transform their agriculture (AGRA, 2013). The economy of Ethiopia is made up of low order (low input-

low output) smallholder subsistence rain-fed agriculture. The sector accounts about 41.6 percent of the GDP, employs about 83 percent of the labor force and contributes around 90 percent of the total export earnings of the country. It is dominated by about 11.7 million smallholder subsistence farmers who cultivate about 95 percent of the national agricultural production (MOA, 2011). This shows that the overall economy of the country and the food security of the majority of the population depend on subsistence agriculture. This belief that agriculture determines the fate of the national development led the current regime to make a strategic shift from industry oriented economy to ADLI in 1990s. The strategy promotes smallholder agriculture via the development and optimum use of agro-ecology sensitive and labor-intensive agricultural technologies and practices (MOFED, 2002). The strategy qualifies the necessity of Schultz's (1964) scientific agricultural doctrine as a priority for (agricultural) development. The government has also developed and implemented such poverty reduction policies as SDPRP (2002/03-2004/05); PASDEP (2005/6-2009/10); GTPI (2010/11 to 2014/15); and GTPII (2015/16-2019/20) as well as food security strategies and programs like FSS, FSP and PSNP meant to reducing poverty and food insecurity at national and household levels. These poverty reduction policies have enabled the country to substantially reduce the national poverty rate from 56 percent in 2000s to 30 percent in 2011 (World Bank, 2015). Nonetheless, these policy changes have not yet changed the production and productivity of the smallholder agriculture of the country (ADC, 2004; Tagel and Veen, 2010). The agricultural sector is characterized by traditional farming (Tagel, 2008) where land, traditional tools, draft animals and family labor are still the most important factors of production in the country. The smallholder farmers are still tilling their plot of lands either using hoes or oxen. In fact, the current structural poverty and food insecurity affecting millions of Ethiopians today reflects the sluggish development of the sector to feed the entire population of the country.

1.2. Statement of the Problem

Food insecurity is undesirable livelihood outcome (Degefa, 2005). It is a fundamental testimony of underdevelopment and backwardness of a nation, region, locality or a household (Wimberley and Bello, 1992). It indeed remains a major social, political and economic concern of nations/regions and households. Food production in Ethiopia has never been sufficient to feed the growing number of population in the last decades. Put it differently, the country has been food deficient since the 1960s (Tagel, 2008). Today, over a quarter of the population of the

country is food insecure (UNDP, 2015). This means one in every four people of the country goes to bed hungry. The effort to address food insecurity in the country has been hampered by multitude of environmental, socioeconomic, policy failures and political crises (Paarlberg, 2002). Drought is the principal shock factor that triggers food crisis in the country. Yet, significant number of people remains in need of food assistance even in years of adequate rainfall and harvest particularly in the lowland areas of the country (Tagel, 2008).

Tigray is one of the most recurrent drought induced food security affected regions in the country (Tagel, 2008; Tagel and Veen, 2010). Food insecurity has been persisting in the region. In 2007, over 58 percent of the total population of the region was living under absolute poverty compared to the 44.4 percent national average (WFP, 2009). The WFP has revealed that the food insecure *Weredas* of the region have increased from 16 *Weredas* in 2000s to 31 *Weredas* in 2009. This means only three *Weredas* are believed to be food secure in the region. Average agricultural yield has remained stagnant in the region over the past decades (Tagel, 2008). The average household level agricultural production in the region covers about 38% of the annual food demand of the households. Only about 17% of households are self-sufficient (ibid). The Food Security Communion of Tigray Region estimates that the average annual crop production in the drought prone *Weredas* of the region covered only 27 percent of the annual food needs of the households living in these *Weredas* (Tagel, 2008). That is majority of the rural households in the drought prone *Weredas* of the region heavily depend on food aid for their survival (Tagel, 2008). Environmental degradation, irregular rainfall, high population pressure, recurrent drought, and institutional factors threaten food security in the region (Tagel and Veen, 2010). A sustained vicious circle of low agricultural productivity, poverty (low income) and low investment exacerbate the structural food insecurity in the region. *Ahferom* is one of the most chronically food insecure *Weredas* in the region (Tagel, 2008). The livelihood of the people has suffered from natural and manmade shocks and stresses including the long-lasting recurrent drought and civil war. The average crop production of the *Wereda* covered 21.38 percent of the annual food needs of the households and hence all households of the *Wereda* might have been facing seasonal food shortages (USAID, 2000).

Food security analysis has long concentrated in and limited to estimation of vulnerability of households to food insecurity (Lovendahl et al., 2004) and calculations of food deficits to be met feeding programs. Food insecurity forecasting capacity also focuses on establishing

different early warning systems based on environmental indicators and behavioral patterns that usually reflect household vulnerabilities (Alinovi et al., 2009). But almost all such statistical methodologies have been unable to predict the real capacity. The main reasons behind the failure to predict future food security situations arise from the complexity and multidimensionality of the concept of food security and the unpredictability of the shocks that cause food insecurity (FAO 2013; Alinovi et al., 2009; Conostas et al., 2014b).

The vulnerability literature and food insecurity forecasting in Ethiopia have led to aid dependent food security strategy and the proliferation of development agencies and nongovernmental organizations providing humanitarian aid and inappropriate development assistance. Ethiopia has thus become a laboratory of experiments in humanitarian aid and development assistance. It has been the leading food aid recipient country in the world (Levinsohn and McMillan, 2007). The households in the study area have been regularly receiving food aid. This food aid may have caused positive and negative dependency where the later compromises the future capacity of the recipients to meet their own basic needs without external assistance (Barrett, 2006). Barrett argues that negative dependency arises when individuals, households or communities alter their behavior in response to food aid and assistance provision which stops them undertaking more autonomous actions towards household level and collective self-sufficiency. Food aid can also be seen as a byproduct of western policies designed to dump surplus agricultural commodities (Levinsohn and McMillan, 2007). It may undermine local agricultural investments, reduce local grain prices and encourages imports which in turn may lead individuals, households and communities to develop dependency syndrome. The impact of conventional humanitarian aid on household food security has thus been questioned (FAO, 2014). Humanitarian aid may protect households from mortality and malnutrition in the face of shocks and stresses but it may hinder fully sustained recovery of households from the adverse effects of shorter term shocks (Vaitla et al., 2013).

Food security studies have also tended to focus on estimating food security statuesque of households. However, the WFS (1996) definition of food security indicates that food security is multidimensional and dynamic. A household is regarded as food secure when it has physical and economic access at all times to sufficient, safe and nutritious food to meet its dietary needs and food preferences for an active and healthy life (WFS, 1996). It must have access to and control over basic livelihood assets which enables it to resist, cope with and respond to external

shocks and stresses. This definition constitutes food availability, food accessibility, food utilization and stability of food supply over time (Maxwell and Frankenberger, 1992) dimensions without each it is impossible to ensure and measure food security. The conceptual and measurement approaches to food security follow these four pillars of it (Barrett, 2010). Food insecurity affects different households differently (WFS, 1996) and hence there exists no agreed standard measure of food security (FAO, 2002). A variety of food security indicators have been developed to measure food security at global, national, regional, household and individual levels. Yet, none of the indicators captures the four dimensions of food security to measure it in totality. Moreover, the different measures capture different food security dimensions and classify food-insecure households quite differently. This study adopts Multidimensional Food Security Indicator to measure food security status of households (Maxwell et al., 2013).

It is a comprehensive study estimating the livelihood asset endowment of households and their contemporary multidimensional food security status as well as their resilience capacity to prevent mitigate and cope with probable shocks and stresses. It is here that the necessity of resilience enters into food security research. Vulnerability and resilience are dynamic and forward-looking concepts. They help us determine the future state of households. There is a substantial literature on vulnerability to undesirable livelihood outcome (Chaduhari et al., 2003 and Calvo and Dercon, 2007) and hence there is no need to research it here again. This study tries to estimate not only multidimensional food security state of households but also their resource endowment and resilience capacity to such undesirable livelihood outcomes. This contrasts with the vulnerability literature that tries to estimate the exposure of the poor to shocks and emphasis what they lack instead of what they have and can do (Moser, 1998).

We live in an increasingly uncertain, volatile, and risk-prone world (Martin and Sunley, 2015). An effective response to reverse such unpredictable and rugged terrain depends on our resilience ability (Zolli and Healey, 2012). Resilience enables households to persist in an uncertain world. Unlike vulnerability which leads households to create dependency syndrome, resilience envisions shock absorbing households. In strict sense, resilience is the capacity to reduce, transfer, cope with and/or adapt to an array of recurrent environmental hazards, economic shocks, health risks, and political instabilities that undermine efforts to generate durable solutions to chronic poverty (Alinovi et al., 2009). Resilience which refers to the ability

of an individual, a household, a community, or an institution to bounce back and persist in chronically vulnerable or food insecure areas of the world has become an important operational concept in the aftermath of the major regional food security crises in the Horn of Africa and the Sahel in 2011 and 2012 (Vaitla et al., 2013 and Maxwell et al., 2013).

The concept and practical application of resilience in food security policy formulation and implementation has become influential in livelihoods research and associated policy developments (Maisonneuve et al., 2014). The popularity of the concept of resilience in humanitarian aid literature is stemmed from the growing awareness that claim natural and manmade disasters and political crises increment and failure of development interventions and humanitarian aids to prevent such humanitarian crises (Maisonneuve et al., 2014). Both the array of shocks threatening the wellbeing of vulnerable households and their ability to respond to such shocks has also been underestimated. This empirical emphasis on resilience over vulnerability shows the necessity of strengthening the capacity of communities and households pulling them out of victim perspective (Twigg, 2009).

Most of the literature about resilience has also been focused on adaptation to climate change. However, scholars such as Alinovi et al. (2009 and 2010); Ciani and Romano (2013) and FAO (2014) have introduced the concept of resilience to food security studies to understand the capacities of vulnerable population in shock-prone areas. The application of resilience of households to food insecurity has initially been empirically tested in Palestine and attracted the attention of contemporary scholars (see Alinovi et al., 2009 and 2010; Ciani and Romano, 2013, Maxwell et al., 2013 and Smith et al., 2014). These authors have considered resilience to be a latent variable defined as “the capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences” (Constas et al., 2014a: 6). Resilience is a dynamic concept that explains how a set of capacities and capabilities can reduce the vulnerability of a household (Smith et al., 2014). The “resilience of a household to shocks and stresses at a given point in time depends primarily on the options available to that household to make a living ...” (Alinovi et al., 2010:17). It also depends on the number of coping strategies available to households and their abilities to adapt and diversify in the face of shocks (FAO and WFP, 2014). The available literature on food crises resilience focuses on conceptualizing and measurement issues of resilience of households/communities to food insecurity. Empirical studies of resilience of households to food insecurity are scanty. These scanty empirical studies

focus at national (panel dataset) level (see Alinovi et al., 2009 and 2010; Kimetrica, 2015; Alfani et al., 2015). Only few scholars such as Vaitla et al. (2013), Maxwell et al. (2013), Smith et al. (2015), and Smith and Frankenberger (2015) have examined resilience of households to food insecurity using primary data.

The conception of resilience in terms of the capacity of a household to absorb, adapt to and transform in the face of shocks and stresses leads us to study resilience through the lens of livelihood analysis. This study tried to amalgamate and study household multidimensional food security and resilience to food insecurity together without which food security studies can inadequately inform food policy and strategy demands of governments. This study therefore attempted to address the following research questions and recommended policies relevant to enhance the resilience capacity of households in the face of shocks and stresses.

1.3. Research Questions

This study is intended to address the following research questions.

- What is the livelihood asset endowment of households?
- Are asset poor households always more food insecure and vice versa?
- What is the multidimensional food security status of the households?
- How severe is the food insecurity situation in the *Wereda*?
- In which dimensions are households food-insufficient and insecure?
- What shocks have been affecting the livelihood and food security of the households?
- How do households respond to shocks and stresses?
- What is the resilience capacity of households to multidimensional food insecurity?
- Are food secure households always resilient and vice versa?

1.4. Research Objectives

The principal aim of the study is to analyze resilience capacity of households to food insecurity in Ahferom *Wereda*, Central Zone of Tigray National Regional State. The study, more specifically, aspires to:

- I. Estimate livelihood asset endowment of rural households
- II. Assess multidimensional food security status of the households
- III. Measure resilience of households to food insecurity

1.5. Scope and Delimitation of the Study

Theoretical delimitation and geographical delineation of a study help a researcher explore and measure the variable of his/her interest to the necessary depth and reduce collection of irrelevant data in the course of the research process. As such, it is important to delimit and delineate the scope of the study. The theoretical foundation of this study covers livelihood asset endowment, multidimensional food security status of households and their resilience to food insecurity. These variables are strongly related to one another and hence it is better to measure them altogether. Measurement of resilience of households to food insecurity heavily relies on the knowledge and analysis of livelihood assets and vulnerability. Yet, complete analysis of all components and dimensions of a livelihood of a household at a time is practically impossible and beyond the scope of this inquiry. This study thus focuses on selective components and variables such as vulnerability context, assets, institutions and organization, social safety-nets and food security which intrinsically affect the resilience capacity of a given household.

Vulnerability and resilience are of two faces of the same coin. They are similar but not synonymous to one another (Schipper and Langston, 2015). Measuring resilience capacity of households can inform you their vulnerability. Resilience is multi-scalar concepts measured at multiple levels. Empirical evidences, however, shows that measuring resilience at household level addresses the question of measurement scale. This study is delimited to resilience analysis at household level. Geographically, it covers rural households in *Ahferom Wereda*, Central Zone of Tigray National Regional State. The inferences and generalizations deduced from the empirical research are replicable to households and areas which have similar socioeconomic fabrics and agro-ecology only.

It is also important to note that this research inquiry has some limitations. This study grossly violates the timing and multiplicity principles of resilience measurement. Resilience should have been measured before and after a shock occurs in order to measure the resilience capacity of a given household should shocks and stresses occur. This study measures the contemporary resilience of households to food insecurity alone because the researcher lacks access to the necessary information (or panel dataset) to capture and quantify their dynamics over time. The unit of analysis of the study is also households which reflect the violation of the multiple level and scale of resilience measurement principle. In fact, it failed to amalgamate the small-scale (household) level resilience capacity analysis with large-scale (national and regional) analysis.

1.6. Significance of the Study

This study has cognitive, methodological, policy and practical significance. First, it attests and promotes two new food security measurement methods empirically: multidimensional food security and resilience of households to food insecurity. Food security measurement that captures all dimensions of food security has been lacking. Different measures capture different food security dimensions and classify food-insecure households quite differently. This study uses MFI (Maxwell et al., 2013). This indicator captures all dimensions of food security and measures it in totality. There are also very few empirical studies on food crises resilience capacity in the food security literature. If not, the resilience studies are fragmented here and there in the literature. This study tried to amalgamate the concept of resilience to and measure by food security. It thus serves as important reference material for further investigation in the food crises resilience literature.

This study can also have the following practical and policy implications. Shocks are natural that cannot be uprooted completely. In fact, scholars have relentlessly been estimating vulnerability of a social unit (such as households) to natural and manmade shocks. This vulnerability literature has led to aid dependent food policy development and proliferation of humanitarian organizations providing aids and assistances to communities and countries in need. Such policies and humanitarian efforts, in turn, have not brought local communities and households to the state of being. Many empirical studies have shown that the local communities and households in need of food aid rather develop aid dependency syndrome and frequently fail to recover from shocks. The international humanitarian experiences and aid provisions to Ethiopia alone can prove the failure of the vulnerability literature and its food aid policy version to empower the target population who has long been receiving food aids. The wrong targeting of food aid recipients has also been aggravating the failure of the approach. Scholars such as Alinovi et al. (2009 and 2010); Ciani and Romano (2013) and FAO (2014) have thus introduced the concept of resilience to food security literature since 2008s. The science of resilience helps us to estimate the real capacity of households to absorb, adapt to and transform in the face of shocks and stresses. Resilience study can also enable analysts and development practitioners clearly identify and delineate resilient and non-resilient social units which in turn help them properly target populations who need assistance. This study, therefore, helps government and nongovernmental organizations and development practitioners properly target the right population in need of help; rethink over sustainable empowerment of the target populations.

1.7. Structure of the Dissertation

The second chapter of the dissertation presents the theoretical literature review and conceptual framework of the study. The literature review has eight sections. The first section introduces the necessity of theory in social science research endeavor. The second section presents the grand development theories underpinning development and underdevelopment of nations/regions. The third section of the literature review presents theories underpinning food security. The sustainable livelihood approach to food security is presented in the fourth section of the chapter. The fifth section describes resilience of households to food insecurity. The sixth section talks about guiding principles of resilience measurement. Empirical literature review is presented in the seventh section. Conceptual framework of the study is presented in the last section of the literature review. Chapter three presents research methodology of the study. This chapter first describes the study area. It then presents the methodology. The methodology section presents philosophical and methodological approaches to the study. The fourth chapter presents rural livelihood asset endowment of households. It has five sections. The first section introduces and describes livelihood assets and their indicators. The second section describes the multivariate method the study employed to generate weights. The third section describes and measures livelihood asset endowments of households using MCA. The fourth section presents asset pentagon the study depicts. The last section summarizes the chapter. Multidimensional food security analysis is presented in the fifth chapter of the dissertation. The chapter first describes the basic concepts and dimensions of food security. It then presents the existing food security metrics. The third section presents multidimensional food security status of households. The last section summarizes the chapter.

Resilience analysis is presented in the sixth chapter of the dissertation. This chapter has seven sections. The first section introduces the concept of resilience in food security literature. The second section describes resilience indicators. The third section of the chapter presents weighting methods. The fourth section describes shock factors and exposure of households to shocks in the area. Resilience capacity analysis is presented in the fifth section of the chapter. Section six presents resilience capacity disaggregation of households. The last section summarizes the chapter. Concluding remarks and policy recommendation of the study are presented in chapter seven. The chapter critically makes generalizations and draws inferences and relevant policy recommendations.

2. LITERATURE REVIEW

2.1. Theoretical Literature

2.1.1. Introduction

This section highlights the concept and necessity of theory in social science research undertakings before it presents the theoretical orientation of the study. Theory is a fuzzy concept that has not universally agreed definition. It constitutes different connotation to different people who have different disciplinary backgrounds. In this paper, theory refers to “a set of interrelated constructs (variables), definitions, and propositions that presents a systematic view of phenomena by specifying relations among variables, with the purpose of explaining natural phenomena” (Kerlinger, 1979: 64 cited in Creswell, 2009). There are also contesting perspectives on the constituent of a theory. Theory constitutes definitions, a domain of applicability, and set of relationships of variables, and specific predictions and factual claims (Wacker, 1998). Likewise, a good scientific theory constitutes the following parameters and qualities: (1) descriptive ability, (2) explanatory power, (3) heuristic value, (4) testability, (5) integrative function (internal consistency), (6) parsimony, (7) clarity, (8) comprehensiveness, and (9) delimitation (Gelso, 2006). Gelso contends that these parameters and qualities of a good scientific theory are based on the fact that theory generates research and research generates and refines theory.

“No science develops in a vacuum, either intellectual or social” (Parsons, 1938:16). In other words, science without theory constitutes an array of disconnected observations (facts) which cannot help to understand the meaning of the physical and psychological world. There also exists a strong connection between theory and research without which science would be impoverished (Parsons, 1938 and Gelso, 2006). Research requires a theoretical frame of reference without which it becomes adventure walking along the unknown world. Contrary to the conviction that theory is necessary to research and vice versa, there still exists a residual belief that theory is unnecessary to research undertaking (Gelso, 2006). Social science scholars have also not only categorically divided into theoretically minded and empirically minded social science scholars but also there has been a “very deep hiatus” between them (Parsons, 1938). Theorists assert that empirical work without prior theoretical orientation and analytical

framework would at best yield meaningless at worst erroneous results while empiricists argue that an intensive empirical work is necessary and a prerequisite to social science theory generation and development. Parsons argues that empiricists are not only uninterested to contribute to theory development but also they are anti-theoretical orientation. Parsons summarized the bitter war between theorists and empiricists as “Empiricists consider any work in theoretical fields as positively pernicious and contrary to the canons of science. It is speculation, sterile dialectic, metaphysics and even mysticism”. On the other hand, theorists “have not only not themselves made distinguished empirical contributions, they have often given the impression of not carrying very much at least about the kind of empirical work which the empiricists have done, of having rather a sovereign disdain for the arduous difficulties of the empirical fields” (Parsons, 1938:14). Nixon (2004) argues in favor of empiricism. Nixon asserts that “the process of theorizing always involves thoughtful practice; thoughtful practice involves engaging with others; and engaging with others always involves the recognition of difference. There is no other way of doing it” (Nixon, 2004:29). Parsons (1938) writes in favor of theorists. Parsons argues that researchers never investigate all the facts which affect the variables of their interest but only those they think are relevant. This involves, implicitly or explicitly, selection of important variables to the study based on their relevance to the logical structure of a theoretical scheme. Hence, any empirical study should be guided by the logical structure of a theoretical scheme.

Categorically, a theory can be either ‘deductive’ or ‘inductive’ (Peet, 1998 cited in Degefa, 2005). The deductive logical reasoning holds the theorists line of argument while the inductive logical reasoning holds the position of empiricists. Philosophically, deductive reasoning shares the defining ontological and epistemological features of positivism paradigm which advocates the existence of objective reality while inductive reasoning holds the postmodernism (constructivism) paradigm which asserts the existence of subjective multiple realities. Quantitative research studies usually follow deductive logical reasoning wherein quantitative researchers deduce and examine hypotheses either to prove or disprove a theory at the beginning of a study (Creswell, 2009). Here, theory becomes the deductive model of thinking and analytical framework for the entire study. On the other hand, theory can have multiple roles in qualitative research studies. It can either be a model of thinking and framework of analysis like in quantitative research studies or an advocacy perspective that shapes research questions, data collection and analysis, and guide researchers delineate important variables; and determine

the position of the researchers in the research processes. Theory generation can also be an end point wherein qualitative researchers deduce hypothesis to generate new theories (Creswell, 2009). They usually gather field data, analyze it and draw generalizations and build a theory. In mixed research approach, a theory can be used either deductively to test and verify an existing theory like in quantitative research or inductively to generate a new theory. Theory thus guides researchers identify the knowledge gap and directs them to conduct fruitful investigation. In this study, multiple theories underpinning food security are used as advocacy perspective guiding the theoretical and methodological frame of reference of the whole study.

2.2. Development Theories Underpinning Food Security

Poverty, food insecurity and hunger are fundamental testimonies of underdevelopment and backwardness of a nation, region, locality or a household (Wimberley and Bello, 1992). They never show human progress or happiness. There exists a strong agreement among social science theorists on the resultant consequences of underdevelopment, poverty and food insecurity. Yet, there is little agreement on the causes of underdevelopment, poverty and food insecurity. The theorists claim and present quite different theories and explanations to the potential causes of underdevelopment and poverty. Moreover, theoreticians and theories play a political role in the field of foreign affairs and international relations (Shalom, 2006) and dictate and shape national policies and strategies.

There are macro, meso and micro level theories underpinning development and underdevelopment of nations, regions, communities and households. Macro (grand) theories are aggregate explanations of development and underdevelopment of nations. They usually explain why different nations and regions of the world experienced differential socioeconomic levels of development. They also compete to dictate and shape socio-economic policies and strategies of third world countries. On the other hand, micro-level theories provide explanations to spatial and temporal development and underdevelopment issues at small-scale (usually household and individual) levels. Meso-level theories link the macro and micro level development theories. However, exhaustive review of the set of past and present development theories and approaches underpinning development and underdevelopment of nations and regions is a very tall order (Bellù, 2011) and meaningless. It is also important to note that there has not been single macro development theory that can sufficiently explain underdevelopment of third world countries. Nor there has been single micro development theory or approach which sufficiently underpins

the widespread poverty and food insecurity in the developing countries. Yet, the macro and micro theories constituting multitude of factors do mediate and interact each other (Jenkins and Scanlan, 2001). The multiple food security theories may overlap one another. This section reviews the major theories and approaches underpinning underdevelopment of third world countries and food insecurity therein. It reviews modernization and dependency theories which claim contesting argument to and underpin underdevelopment and food insecurity.

2.2.1. Modernization and Dependency Perspectives on Food Security

Modernization theory is the extension of the early European enlightenment. The origin of the contemporary modernization theory is, nevertheless, traced back to the response of American political elites and intellectuals to the international setting of the post-Second World War era (Tipps, 1973). The theory is the outcome of the combined effect of decolonization of third world countries and the emergence of cold world war that led USA and Soviet Union (superpowers of the time) to compete to dominate the international economic and political order (Tipps, 1973; Shalom, 2006). The emergence of impoverished third world countries attracted the academia and political elites of American and Soviet Union social scientists who proposed a liberal modernization and communism to eradicate underdevelopment of the third world, respectively. Consequently, modernization theory became the most popular and influential economic theory used to explain the underdevelopment and widespread poverty in the non-western countries of the world (Peet and Hartwick, 2009).

Modernization refers to a social imagination of change. It is usually equated with and characterized by widespread literacy, urbanization, industrialization, economic growth, rationalization, structural differentiation, political development and secularization each of which represents a source of change operative at the national level (Tipps, 1973; Garon, 1994). The theory spells out the geography of a global system into (1) centers of modern progress and (2) peripheries of traditional backwardness where the center (the western world) showing the peripheries (everyone else) their future (Huntington, 1971; Tipps, 1973; Peet and Hartwick, 2009). In other words, the theory divided the world community into “primitive or traditional” and “modern” dichotomy each of which has very distinctive attribution. Modernization theorists also believe on the existence of a linear evolutionary pathway from tradition to modernity that every society could, and should, take (Unger, 2007). The essential difference between modern and traditional society lies in the greater control which modern man has over his natural and

social environment through the expansion of scientific and technological knowledge (Huntington, 1971; Peet and Hartwick, 2009). In this sense, Rostow (1960) structured modernization theory and divided it into such five stages of economic growth pathways as traditional; the preconditions for take-off; take-off; drive to maturity; and age of high mass consumption in which any societies should undergo in order to modernize and achieve economic development (Tipps, 1973).

Modernization theory pinpoints factors impeding advancement of a society towards industrialization; differentiate the conditions and mechanisms of transition of a society from traditional way of life to modern way of life (Peet and Hartwick, 2009). The theory basically ascribes the sources of development and underdevelopment of third world countries to domestic parameters (Jenkins and Scanlan, 2001). It contends that underdevelopment and widespread poverty of third world countries are attributed to the social, cultural and religious traditions of the societies themselves (Jenkins and Scanlan, 2001; Willis, 2005). It asserts that domestic investment and educational growth leads into industrialization and cultural modernization which in turn bring about economic growth. The theory assumes that economic growth usually trickles down to increase social welfare of the populace in the long-run (Jenkins and Scanlan, 2001). Hence, modernization theory premises transfer of modern technologies, foreign capital (investment), management skills, and modern cultural values from the western society to nonwestern society and encourage trade interdependency between them in order to modernize the nonwestern societies. The theory argues nonwestern societies will have access to modern technologies, foreign capital and export markets that are essential for development via international trade, foreign investment and international aid and hence they tend to benefit from the international trade and economic linkages with the western societies. The western societies, on the other hand, will get cheap raw materials, investment opportunities and markets and benefit from the international trade interdependence (O'keef and Li, 2011; Subramaniam and Bunka, 2013).

Paradoxically, dependency theory ascribes the sources of development and underdevelopment of nations to exogenous factors. The dissatisfaction of Marxian inspired Latin American radical economic theoreticians in modernization theory and the economic policy failure of the UNECLA have contributed to the emergence and development of dependency theory (Huang and Słomczyński, 2004). The theory advocates that the capitalist economic structure of the

world has been fundamentally flawed, “ethically challenged,” morally wrong, and dangerous to people and the planet (Peet and Hartwick, 2009). Huang and Słomczyński argue that the UNECLA strategy of protectionism and industrialization brought about broad based economic crises such as unemployment, inflation, currency devaluation, declining terms of trade in the region. In other words, the adverse impact of the integration of Latin American economies to the world monopolist capital economy of the 20th century on the local economy of the region made the theorists find out alternative explanations of “Development of Underdevelopment” in third world countries. Dependency theory holds that development of underdevelopment has been the cumulative outcome of historical processes and structural arrangement of world capitalist economic system and political order (Willis, 2005). The theory contends that development of western societies was categorically at the expense of nonwestern societies whereby the former destructed the indigenous knowledge and institutions; and looted natural and human resources of the later (Peet and Hartwick, 2009). Frank, the popular dependency theorist, asserts that development of underdevelopment was neither an original condition of third world societies nor the outcome of the archaic institutions of the regions. It also did not stem from Third World irrationalism. Instead, development of underdevelopment was the result of exploitative economic relationship between the center and periphery. The underdevelopment of the periphery has been characterized by the contradiction of the monopolistic expropriation of economic surplus; the contradiction of metropole–satellite polarization; and the contradiction of continuity in change (Peet and Hartwick, 2009). This exploitative chain of capitalistic exchange (or spatial expropriation) began at the local periphery where landowners exploited smallholder farmers and went through a series of chains until the core (western capitalists) took all the resources of the periphery (Willis, 2005). Let us now highlight the implication of modernization and dependency theories to underdevelopment and food insecurity.

Modernization and dependency theories provide contending conceptual explanation for the underdevelopment of third world countries and the widespread poverty and food insecurity therein. Unlike modernization theorists who assert underdevelopment and widespread poverty of third world countries to the social, cultural and religious traditions of the global south societies themselves, dependency theorists ascribed them to exogenous factors of global capitalistic production and trade structure (Willis, 2005). Modernists have also structural and psychological dimensions in which the structural dimension constitutes a uniform, evolutionary vision of economic, social and political development along the path of industrial first world

capitalism and democracy (Peet and Hartwick, 2009). Dependency theorists nevertheless see the socio-cultural, psychological and political dimensions as natural products of dependency. The economic dimension of the theories constitutes international trade, external debt, and foreign direct investment (Huang and Słomczyński, 2004). Modernization theorists encourage trade interdependence between western and nonwestern societies and transfer of modern technologies and foreign direct investment from the former to the later, whereas, dependency theorists see the economic dependency detrimental to the nonwestern countries (Ahiakpor, 1985). The economic dimension of modernization and dependency theories such as international trade structure, transfer of modern technologies and foreign capital investment between western and nonwestern societies affect food security of the later directly through wages and labor market dynamics, environmental effects, demographic and migration forces, and distributional implications and indirectly via growth and development (O'keef and Li, 2011).

The empirical literature on impacts of modernization and dependency theories on food security provide contesting evidences. Adherents of modernization school argue that international food order, foreign investment and transnational corporation penetration tend to reduce the widespread food insecurity in nonwestern societies. They, for example, argue that foreign capital inflows and transfer of modern technologies and technical knowhow from western to nonwestern societies increase the absolute incomes of all classes of the later societies (Deardorff and Stern, 1994 in O'keef and Li, 2011). Conversely, the dependency thesis contends that international food order, foreign investment and transnational corporation penetration into third world countries have adverse impacts on their food security. Friedmann made a historical analysis of the postwar international food order and conclude that the "fall of the international food order was the underlying cause of the sudden growth in hunger in the Third World (1982: 282). Friedmann asserts that the United States of American hegemony since the postwar adversely affected the international food order. It is also evident that the Multinational Corporations (MNCs) and the global markets have already penetrated into local economies and made local markets vulnerable to global price volatility and economic shocks (Maxwell, 2012). Watts (1983), for example, argues that capitalism and commoditization had adverse impacts on food security of the rural poor in Africa. Watts asserted that food production per capita declined and many rural producers confronted annual grain purchase to fulfill their domestic demand.

A study on effects of FDI, exports, and economic growth on third world food consumption also asserts that primary export dependency and transnational corporate investment exacerbate food insecurity while economic growth mediates it (Wimberley and Bello, 1992). Jenkins and Scanlan (2001) summarized the adverse effect of FDI on third world economies. They assert that (1) MNC repatriate their profits and discourage domestic investment and capital formation; (2) FDI depends on high-tech technologies which absorbs less labor and highly paid technocrats leading to income inequality; (3) FDI focuses on export cash crops and industries which have weak ties to and lower spillover effect on domestic economy; and (4) MNC usually oppose social welfare programs that benefit the poor and enforce governments to make infrastructure investment that compromise social welfare programs. A sectoral analysis made on the effects of FDI on food security in third world countries shows disparate attributes of each sector on food security (O'keef and Li, 2011). The authors disaggregated foreign direct investment into primary (agriculture), secondary (manufacturing) and tertiary (service) sectors and found out that FDI on agriculture causes food insecurity while FDI on manufacturing improves it. They also assert that FDI on service sector has an ambiguous otherwise negative effect on food security in third world countries. This study postulates that the persistent food insecurity in Ethiopia is the outcome of the impact of both modernization and dependency theories on the national development policies and strategies. It adheres that both domestic parameters and international factors have contributed to the widespread food insecurity in the country.

2.2.2. Postmodern Perspective on Food Security

Postmodernism has not merely chronologically followed modernism but also it stands against modernism and might better be called anti-modernism (Barrett, 1997), Post-development or anti-development. Post-development theory refers to the theories and practices which have most commonly been associated with the term development in the postwar era (Matthews, 2004). The theory is a critique of development theories and practices of the western hegemonic world ideology. It constitutes such various anti-postwar development theories and thoughts as post-structuralism, postcolonial studies, cultural studies, radical feminism, and de-constructivism each of which focuses on different issues and reflects a different political agenda (Shalom, 2006). However, they have a common epistemological claim of denying an objective and universal foundation for sciences. Shalom asserts that unlike positivists who consider theory as an objective, universal and ideology free foundation, postmodernists consider it a

sham, an ideological myth obscuring the true nature of science, a servant of the current exclusionist social status quo. Unlike Marxian and neo-Marxian theorists who focus on class interests, postmodernists emphasize on radical anti-capitalist struggles (Pieterse, 1998).

Postmodern theorists do altogether have pronounced the inapplicability and doomsday of the postwar development theories and practices. They contend that the postwar development theories and practices have failed to bring about a significant change in third world countries because the entire concept of development is western and non-universal measure of progress (Karplus, 2014). Postmodern theories stemmed from a simple realization that attaining a middle-class life style in majority of the nonwestern societies of the world population has been impossible (Dasgupta, 1985). In fact, postmodern theorists heightened to challenge and reject the conventional theories and practices of the postwar era that modernists held. The postwar development project had not led to a process of catching up for most of the developing world it has rather widened the gap between the rich and the poor countries (Sachs, 1992). Likewise, Escobar (1992) asserts that the postwar development discourse has created an extremely efficient apparatus for producing knowledge about, and the exercise of power over the third world countries. The postwar development theories and practices which had been imposed on the third world countries was basically the wrong answer to the needs and aspirations of the people of the region (Rahnema, 1997). Rahnema contends that the ideology was born and refined in the North, mainly to meet the needs of the dominant powers in search of a more appropriate tool for their economic and geopolitical expansion. He asserts that the hidden yet clear message that every development theory and practice has carried to the people at the grassroots has been that their traditional modes of living, thinking and doing have doomed them to a subhuman condition. Matthews (2004) added that postwar development project has been misconceived and hence failed because it has been initiated based on the western experience, and did not take into account the diversity of experiences, needs and aspirations of those it claims to assist.

Post-development theorists are categorically divided into first wave or anti-development theorists who reject the whole version of postwar development projects and second wave or skeptical post-development theorists who call for alternatives to development (Kippler, 2010). The first wave (anti-development) postmodern theorists who wrote in the late 1980s and 1990s have often been critiqued for their rejection of the whole postwar development project without

portraying why it is bad (Karplus, 2014). The second wave or skeptical post-development theorists criticize the de-politicization of the economic versions of the postwar development agenda (Kippler 2010). They argue that the development discourse has incorrectly removed the development objectives and goals such as poverty and food insecurity reduction from the political sphere and extradite them into the hands of scientific experts who are apolitical. Escobar (1995) argues that the postwar development project categorized the world societies into developed and underdeveloped areas based on the western values and economic systems. Escobar underlines that the nonwestern societies became underdeveloped and wrapped up into a single homogeneous minority in the postwar era. They were denied of being what they were and were transmogrified into an inverted mirror of other's reality. They were relegated into the bottom edge of the global economic system and hence they need development (Escobar, 1995). The removal of development agendas from the political sphere and extradition of these agendas into the hands of the development experts and technocrats ignored the root causes of poverty and food insecurity. This is because poverty and food insecurity is the combined outcome of the absence of power and knowledge not merely the outcome of the later. The post-development theorists argue that the institutionalization of the development ideology led to a professionalization of development practitioners who have the knowledge and took the power to change the third world society out of the local people. The development experts then became the veto power holders to decide what to change and how to enact it in third world countries (Karplus, 2014). Escobar (1992) argues that the deployment of technical experts and institutionalization of development in third world countries made their culture and economy new objects of research and knowledge and created new possibilities of power.

This paper indeed argues in favor of and adopts the second wave of (skeptical) post-development theorists' position who accuses the elite and state leaders of the third world countries. The skeptical post-development theorists believe that the postwar development projects are the extension of and means to implement modernization theories which presuppose that western values and structures are the only acceptable model for progress (Karplus, 2014). Unlike the first wave of post-development theorists who believe that development is intrinsically flawed and must be rejected (Pieterse, 2000); the second wave of post-development theorists calls for alternatives to development. Yet, the search for alternatives to development requires a theoretical and practical transformation of the notions of development, modernity and the economy (Escobar, 1992). Postmodernism rejects positivism and the scientific methods of

inquiry and the meta-narratives of development (Maxwell, 1996b). It has tried to destruct the established ontology and epistemology of western modernity, and the conventional development theories and practices. Postmodern theorists promote indigenous knowledge, local culture and pluralism. Matthews (2004) argues that while there are many development theorists who are disillusioned with and critical of development theory and practice, what distinguishes the post-development perspective from other critical perspectives is that post-development theory pronounces the demise of development and urges for alternatives to development rather than alternative development. It is important here to underline that the rejection does not refer to the complete rejection of the development discourse and practice because post-development theorists dream for and work to bring about what Robert Chambers (1995:174) called “good change”. Matthews argues that post-development theorists do not reject the development versions and practices that can help the underdeveloped society undergo some transformation which will result in a better life for its inhabitants. Hence, when they reject development, it refers to the rejection of the postwar theories and practices which have since 1950s been associated with the term development. He argues that the call for an end to development should not be interpreted as a belief that the bettering of social organization is impossible, nor does it a call for a return to earlier ways of life. In other words, the call for alternatives must not be read as a call for the rejection of the desirable change in the direction of improving societies, nor does it disregard the desire of the poor who need to see improvement in their situation (Matthews, 2004). Conversely, post-development theorists invariably call for alternatives to development. Yet, the alternatives to development they offer are not comprehensively described nor featured in detail in much of the development literature (Matthews, 2004).

The term development encompasses a broad range of concepts, services, objectives and goals. Food security and resilience to any unnecessary development outcomes are among such development goals. A progressive change of a household, community, region and a nation from vulnerability to food insecurity towards food sufficiency and resilience to such undesirable development outcomes have been considered as desirable development goals. The ontological (multiple reality) and epistemological (multiple methods) positions occupying postmodernism are central to the contemporary food security thinking. In other words, the characteristic features of postmodernism became central to food security understanding and measurement. Let me now come down to the specific theories and approaches underpinning food security and the conceptual framework the researcher adopts in this research study.

2.3. Theoretical and Conceptual Approaches to Food Security

2.3.1. Concepts and Indicators of Food Security

It is important to first highlight the concepts and indicators of food security prior reviewing the theories underpinning it. Food insecurity leads to substantial productivity losses and misallocation of scarce resources. It consequently lowers cognitive development and school performance of people and made them pass inefficient decisions on their daily lives. The world (or mankind) has now the ability to produce enough food for all its inhabitants. Hence, famine and food insecurity are no more acceptable (WFP, 1996; Sarracino, 2010).

Food security is a multidimensional and multi-scalar concept that has gone significant conceptual transformation since the First World Food Conference of 1974 (WFP, 1996; Maxwell, 1996b). It has shifted from global and national food supply concern to the household and the individual food access concern. It has also shifted from a food first order perspective to a livelihood perspective; and from objective indicators to subjective perception (Maxwell, 1996b; Carr, 2006; and Koc, 2013). Food security has got over 200 definitions in the literature. It hardly needs to be defined here again (Maxwell, Coates and Vaitla, 2013). This study adopts the WFP (1996) definition of food security which refers to “The physical and economic access at all times to sufficient, safe and nutritious food to meet the dietary needs and food preferences for an active and healthy life”. This definition constitutes food availability, food accessibility, food utilization and stability of food supply over time (Maxwell and Frankenberger, 1992) dimensions without each it is impossible to ensure and measure food security. It is also important to note that the stability dimension of food security is crosscutting and applicable to all the three dimensions (Maxwell and Frankenberger, 1992).

Food provision has long been national and international priority. In the postwar era, the prevailing international food policy priority in the west has been the modernization and rationalization of production and removal of obstacles to international trade. The scientific progress over the decades has confirmed that food security has multiple dimensions which led to multiple theoretical formulations and reformulations of the causes and analytical frameworks (Yaro, 2004). These multiple dimensions, causes and consequences of food insecurity differ from country to country, region to region, and even within the same locality (Waal, 1989). That is food security has spatial and temporal dimensions. It affects households, communities and nations in a definite space over a certain period of time (Degefa, 2005). Hence, there is no one

general theory that fully explains food insecurity (Sarracino, 2010). In fact, there are multiple theories underpinning food insecurity. These theories have evolved in a linear fashion from Malthusian Population Principle which focuses on FAD to entitlements failures, and eventually to livelihood frameworks that maintain entitlements at the core of food security explanation (Yaro, 2004). The following section presents the specific food security theories and approaches in their chronological and logical order moving from the oldest and narrower version of food security to the recent broad-based ones.

2.3.2. Food Availability Decline (FAD)

FAD is the oldest and most influential approach to food security discourse and analysis. The Malthusian Population Principle underpins the FAD and is known as the Malthusian approach (Burchi and Muro, 2012). Malthus ascertained the necessity of food to the existence of man and the biological imperative of sex for human race continuity. Malthus argued that the power of population, unless checked, exceeds the power of the earth to feed its population (Emmett, 2006). Malthus contended that there is no infinite population growth in a world of finite natural resources (Sarracino, 2010). In other words, Malthusian Population Principle underlies that population growth will leave people out of resources to sustain consumption. Malthus claimed that the consequences of population growth above the available food would be starvation, disease, and mortality (Sen, 1981b; Emmett, 2006; Sarracino, 2010).

This narrow traditional approach which focuses on a single agricultural sector has long dominated the international food security discourse and analysis. In other words, the recurrent international food supply shortage has led scholars to retrograde the international food discourse to the traditional food availability decline. The approach focuses on the equilibrium between population and food supply. It adheres that the growth rate of food availability should not be lower than the growth rate of population in order to maintain the equilibrium between the population and food supply (Burchi and Muro, 2012). The approach advocates that food supply shortfalls are the main causes of food insecurity (Yaro, 2004). It underlines that insufficient production and availability of food are the main causes of food insecurity and starvation. This has led to huge investments in green revolution technologies designed to increase food supplies for both national self-sufficiency and for export. Food security thus requires food availability expansion (Sarracino, 2010). Consequently, food security was defined and understood in terms of aggregate food availability at international and national level which was reflected at the first

World Food Conference (1974). The conference defined food security as availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices. The approach explicitly constitutes population growth rate checks and per capita food (agricultural) production and productivity increment policy prescriptions.

Methodology and unit of analysis are important selection criteria of which approaches one can use to analyze food security. They also determine the policy implication of a social science research. The unit of analysis in social science research ranges from the world, to a country, a region, down to a community, a household, or a single individual. It can also be a single sector, a cluster of sectors or can be economy-wide. The units of analysis in food availability approach can either be a nation and its food balance sheet, the world, and the agricultural sector and its production and productivity (Burchi and Muro, 2012). Consequently, food insecurity indicators such as food balance sheet showing shortfalls or deficits in the supply of basic foodstuffs in relation to aggregate population have been frequently used to determine food security status of nations and regions. Likewise, supply side parameters like food production, resource endowment, technology generation and dissemination, climatic conditions, market opportunities and price fluctuations received important attention in the food security discourse (Yaro, 2004). Nevertheless, the simple realization that adequate food availability at global and national level alone does not guarantee food security of all citizens of a nation has led scholars to search for alternative theories underpinning food insecurity. In other words, the Malthusian FAD thesis has received serious critiques. For example, the approach deals with global and national food supply alone. It denies the hard fact that food insecurity can occur when food supply does not meet the effective demand of an individual, a household or a population for food; i.e. food shortage can occur either by short of supply or lack of effective demand; not necessarily by the former or the later alone. In other words, the FAD is flawed thesis in the sense that a few commercial farms can produce most of the food in an economy. The celebrated Economist Amartya Sen (1981b) who pioneered the entitlement approach asserts that food shortage can occur without any food supply decline over time since the market demand can sharply rise over time. The FAD approach says nothing about the income and purchasing power of individuals and households which determine their effective demand. This confirmation of unequal access to resources and differential purchasing power of individuals and households leading to unequal distribution of food brought the entitlement approach to the forefront (Yaro, 2004).

2.3.3. Food Entitlement Decline (FED)

The FAD thesis has failed to explain the persistent food insecurity and hunger in a plenty world of food supply. This theoretical failure led theorists to search for alternative explanations for the persistent food insecurity. Amartya Sen (1981b) who originally introduced and framed the FED asserted that food insecurity is not only an outcome of FAD but also entitlement failure. There is a wide array of literature about the capability approach which is originally called entitlement approach. I, nevertheless, retain here the original nomenclature and used it throughout this paper for the ease of simplicity. The capability approach is a broad normative analytical framework used to evaluate the ends and means of wellbeing and development. It is used to evaluate people's capabilities to function (ends of wellbeing) in order to lead the kind of life they value most and have there being enough means (resources) necessary to meet these capabilities (Robeyns, 2005). The focus of the approach on capabilities to function does not necessarily mean it ignores the necessity of resources, social institutions, economic systems and technical progress in empirical analysis. It rather implies that the approach judges development in terms of human freedom which requires an instrumental means to realize it (Robeyns, 2005). This study therefore intends to evaluate whether people have sufficient food supplies and entitlements to it in order to lead well-nourished life without which one cannot have the capability to function and live the kind of life s/he values.

Entitlements depends on (1) endowment sets which refers to all tangible and intangible resources a person legally owns such as land, livestock, house, knowledge and skill, labor power; and (2) entitlement set which refers to the set of goods and services that a person can legally obtain by or have access to through trade and production, i.e. the "exchange entitlement mapping using the resources of his endowment set (Osmani, 1993). The entitlement mapping mediates the relationship between the endowment set and the entitlement set. It shows the rates at which the resources of the endowment set can be converted into goods and services. Entitlement set of a person consists of the endowment vector x , exchange entitlement mapping which specifies the set of commodity bundles any one of whom can choose to have through exchange (trade and production) and social security (state entitlement transfers) provisions when s/he fails to support him/herself (Sen,1981b). A person's "entitlement set" is the full range of goods and services that he or she can acquire by converting his or her "endowments" (assets and resources, including labor power) through "exchange entitlement mappings" (Devereux,

2001). The exchange entitlement mapping usually depends on legal, political, socioeconomic characteristics of the society in question and the personal position s/he occupies in it. In agrarian societies where agricultural production makes the overall national economy, the entitlement set of an individual depends on production opportunities and trade possibilities of resources and products s/he can do (Sen, 1981b).

The introduction to and application of the FED in food security discourse has shifted the definition of food security from a mere food supply to the multidimensional food security (WFP, 1996) definition which refers to “The physical and economic access at all times to sufficient, safe and nutritious food to meet the dietary needs and food preferences for an active and healthy life”. It has also shifted the unit of analysis from national food supply to an individual person, the analytical and information necessity of food security analysis. It has ascertained that the presence of enough food per capita at national level is merely a necessary but not sufficient condition for food security (Burchi and Muro, 2012). Hence, food security analysis needs an extensive information base of national food availability down to regional and local availability and households and individuals access to food. Nevertheless, the analysis can be conducted at collective levels such as household, group, or class by using the standard device of assuming a 'representative individual (Osmani, 1993) for practical purposes. Food security analysis using FED requires endowment variables such as productive and non-productive assets, non-tangible resources such as education, employment as well as wage information; and prices of food and nonfood items. It permits analysts to predict future food deprivations. That means a lower asset endowment assures that households will face critical constraints to access enough food in the future. Conversely, households having a large entitlement set or asset endowments might not face food security problems any more (Burchi and Muro, 2012).

Moreover, FED approach to poverty, food insecurity and famine theorizing has shifted the analytical focus away from the mere fixation on the Malthusian principle of overpopulation growth devastates humanity to the lack of food people want to acquire it. Food insecurity affects people who have no access to adequate food irrespective of food supply. It also emerges due to exchange entitlement decline and direct entitlement failure. Of course, the FED incorporates the FAD and conceptualizes it as a direct entitlement decline or production-based entitlement failure (Devereux, 2001). The entitlement failure emanates either from direct entitlement failure like reduction of food production for personal consumption or trade entitlement failure or fall in

food exchange rate. Food producers usually face both direct entitlement failure due to production decline and exchange entitlement failure while nonfood producers do experience the trade entitlement failure due to failure in terms of change, the total availability of food declines; or both (Burchi and Muro, 2012). Devereux (2001) contends that food insecurity emerges when the entitlement set individuals entitled to do not provide them adequate food for subsistence. Hence, the FED approach asserts that food might be available in the market but that people may still lack the means to acquire it (Sen, 1981b; Osmani 1993).

The FED does have multiple critiques and counter critiques. The approach does not account for or misinterpret such important causes and consequence of food insecurity as starvation by choice, disease-driven rather than starvation-driven mortality, ambiguities in entitlement specification (fuzzy entitlements), and extra-legal entitlement transfers (Devereux, 2001; and Yaro, 2004). Unlike Sen who subscribe the fall of the actual food consumption of people below their entitlement to low order parameters like ignorance, fixed food habits, and apathy, the current literature on entitlement attributes the choice of people to starvation to a deliberate plan of action households take to reserve their key productive assets and social relations and power inequalities. Devereux (2001) went further and asserts that people choose to starve not only to reserve the key productive assets that guarantee the long-term livelihood of a household but also the weak members scarify their life because they lack power. Devereux argues that the model does not account for and silent about such apparent violations of fundamental human right to life. In other words, food insecurity is not merely FED but it can also be a political economy failure. The approach is also very narrow that it considers food access as the final goal of human development. Nonetheless, food is only one among the numerous human necessities and livelihood activities people pursue. It also considers the poor as passive agents who wait to die when they lack food which contradicts with the multiple coping strategies the poor usually pursues (Yaro, 2004). These multiple critiques on FED remind us that there exist food insecurity causal factors that are not explained by entitlement failures.

2.3.4. Political Economy Approach (PEA)

The complexity of the contemporary food security crisis requires a comprehensive view of the global food system. This comprehensive understanding of the whole food system and food security dynamics requires a clear understanding of food production, processing and distribution inherent in the natural setting, socioeconomic and political history of a nation state

(Subramaniam and Bunka, 2013). It is hence imperative to review the political economy of food security in order to uncover factors beyond supply and demand forces. Political economy studies economic problems within the historical context of social and power relationships. It uncovers the social relationships and power inequalities between societies. The PEA has historically been a normative analytical approach which recognizes economics and politics constitutes each other (Chandhoke, 1994). It also refers to the interrelation between government actors and society and the economic policies and actions the former enacts to (usually) improve the livelihood of the later (Degefa, 2005). Yet, famine crises have recently become much more complicated than ever before and consequently changed the political economic nomenclature to the Complex Humanitarian Emergencies (CHE) in the famine and food security literature. This CHE requires holistic perspective to understand and differentiate the social, cultural, political and economic factors causing famine. This PEA constitutes a range of micro theories of famine including ecological degradation, inappropriate development strategy, government policy, and war and civil strife (Degefa, 2005). CHE refers to a profound social crisis in which large numbers of people enter into and unequally suffer from war, displacement, hunger, diseases attributing to manmade and natural disaster. It refers to a situation in which physical fighting between people leads to a huge amount of human suffering and death arising from the direct fighting and the indirect effects of the conflict on food supplies. They are characterized by unpredictable, sudden and concentrated shocks which erode productive assets. They also have unequal impact on different social classes and societies (Sarracino, 2010).

Natural and manmade or a combination of both causes food security crises. In fact, natural hazards are not natural alike we thought though drought may trigger famine which reflects the inability of a sociopolitical economic system to cope with unusual ecological conditions and their effects (Watts, 1983). Maxwell (2012) asserts that the contemporary protracted crises might have caused by multitude of unknown factors including demographic changes, urbanization of poverty, vulnerability and hunger, climate change, globalization. Indeed, it is no longer meaningful to categorize disasters into natural and manmade crises or emergencies. Protracted long-lasting crises which might have caused by a multitude of factors have become a norm in the world. Unlike emergencies which have short-term episodes and clear causes, beginning, and ending, protracted crises are irreversible and never ending. Countries in protracted crises experience weak governance, crackdown of institutions and social services, conflicts and civil strife. Ethiopia has experienced 15 natural and manmade protracted crises

between 1996 and 2010 (Maxwell, 2012). The impact of protracted crises on livelihood systems and food securities is severe. Food insecurity prevalence in countries suffered from protracted crisis is three times higher than other developing countries. In the natural disasters, the state often tries to respond and mitigate to the crises while in the later internal conflict and political instability can it well be part of the crises (Maxwell, 2012).

Government policies and programs may favor to and undermine the ability of a particular section of the population to command food (Dreze and Sen, 1989). They contribute to the occurrence of food insecurity and famine via inappropriate policies (Sahelian famines and the Chinese famine of 1958–1961); failure to intervene (the Bangladesh famine of 1974 and the Ethiopian famine of 1974 and 1984); political instability (Zimbabwean and North Korean famine of mid 1990s, Ethiopian famine of 1985 and Somalia of 1990) (Sen, 1981b; Devereux, 1993; Maxwell, 2006b; and Lin and Yang, 2000). A combination of natural shocks (drought) and manmade disasters (government policy failures and political instability) can also reinforce one another and cause food insecurity and famine (2010 Haiti earthquake; and Ethiopian famines of 1972/73 and 1984/85) (Lautze and Maxwell, 2006). The persistent food insecurity and famine in Tigray has been attributed to the biased (otherwise wrong) political economic approaches of the past and present regimes to the region and the natural shock factors. The region has historically been a warzone of internal conflicts and external invaders which has been undermining development endeavor and food security efforts.

Food insecurity is neither the outcome of FAD alone nor merely FED. Nor the political economy approach alone underpins it. This study claims that each of these approaches does explain food security where some households could be food insecure merely because of FAD while others might lack full entitlement to foodstuffs. Political and economic crises (Tagel, 2008) and lack of interest in and delay of international donors to provide food aid and assistance can also trigger food insecurity.

2.4. Sustainable Livelihood Approach (SLA)

The SLA has been used to conceptualize and analyze poverty and food insecurity since 1980s and 1990s respectively (Degefa, 2005; and Morse, McNamara and Acholo, 2009). I here retain both usages of the approach to understand and analyze food security of households and their resilience capacity to it. The approach goes beyond the conventional mainstream economic

approaches to analyze food security. It focuses not only on income but also on vulnerability and social exclusion (Krantz, 2001). But it is important to first clarify the concept of livelihood prior presenting the necessity and basic features of the framework. Livelihood refers to the capabilities, assets and strategies and activities households pursue to meet their means of living. A livelihood becomes sustainable when it can cope with and recover from stresses and shocks maintain or enhance its capabilities and assets, while not undermining the natural resources base (Chambers and Conway, 1991; and Scoones, 1998).

The SLA has explicitly been people-centered, holistic, dynamic and iterative, and links macro and micro development initiatives to help households achieve their livelihood objectives on sustainable basis (DFID, 1999). It is used to analyze the ability of social units to enhance their assets and capabilities in the face of shocks and stresses over time. The approach helps analysts identify the multitude of factors which constrain the livelihood of the poor and the opportunities they have to enhance their livelihoods on sustainable manner (DFID, 1999; Morse, McNamara and Acholo, 2009). The framework focuses on participation and empowerment and views food insecurity in a multidimensional perspective (Frediani, 2010). It helps analysts estimate the available livelihood assets households are endowed with and strategies they pursuit to achieve food security. In other words, it helps analysts understand asset endowment of households and their endeavor to convert the assets into positive livelihood outcomes. The framework summarizes the main components of and influences on livelihoods of the poor. The framework does not provide a magic solution to food insecurity. Yet, the core ideas and principles that underlie it should not be compromised in food security analysis (DFID, 1999).

Food security of households depend on the interplay between the vulnerability context they live in, access to livelihood assets, the mediating processes, activities and strategies households pursue to achieve livelihood objectives (Scoones, 1998; DFID, 1999; Degefa, 2005). It is only when these livelihood components are considered can it be possible to develop livelihood strategies that can reduce food insecurity of households and enhance their resilience to it (Krantz, 2001). Yet, the approach does not try to address all dimensions of livelihood of the poor (DFID, 1999) at a time. There also no standard procedure to apply the approach in any development initiative and analysis (Krantz, 2001). It is necessary to examine each of the core components of livelihood embedded in the approach in order to understand the framework and apply it to analyze household food security. The following section highlights the core

components of the livelihood approach through a series of permutations produce livelihood outcomes.

2.4.1. Livelihood Resources (Assets)

The ability of households to pursue different livelihood strategies depends on their access to and control over basic materials and social, tangible and intangible assets (Scoones, 1998). Households require a range of assets to achieve positive livelihood outcomes. A single asset can also generate multiple benefits to a household. Nonetheless, mere asset endowment of households does not lead them to food security. Hence, analysis of asset endowment of households requires examining sequence, substitution and clustering of assets; and households access to assets and tradeoffs between different livelihoods strategies they pursue over time (Scoones, 1998). The framework identifies five core assets upon which household livelihoods are built (DFID, 1999). Let us now look at each of these livelihood assets.

Human capital is an intrinsic value which enables individuals to make use of other assets (DFID, 1999). It comprises skills, knowledge, ability to work and good health that altogether enable people to pursue different livelihood strategies to reduce food insecurity (Scoones, 1998; DFID, 1999; Krantz, 2001). Human capital for a typical rural household represents the number and quality of labor available that varies according to size, skill, and health condition of household members (DFID, 1999). Yet, literacy and health condition of household members that matter most today to reduce household food insecurity (Degefa, 2005).

Social capital refers to the social resources upon which households demand to pursue different livelihood strategies (Scoones, 1998; DFID, 1999; Krantz, 2001). It protects unwise use of public goods, facilitate innovation and help the poor improve their income. Households and individuals who have good social capital can easily cope with and respond to shocks and stresses.

Physical capital comprises the basic infrastructure and producer goods and services necessary to undertake livelihood strategies (DFID, 1999). Physical capital is important only if it supports the poor to meet their desirable livelihood outcomes. It directly or indirectly affects the human and financial assets of households (Scoones, 1998). Physical capital can be either a public good or a private good (DFID, 1999).

Natural Capital denotes the natural resources stocks and environmental services from which resources and services important to household livelihoods are derived (DFID, 1999; and Krantz, 2001). Natural capital is necessary to all human beings. Yet, it is mandatory to rural households who derive all (or part) of their livelihoods from agriculture and agriculture related activities (DFID, 1999).

Financial capital denotes the financial resources that people use to achieve their livelihood objectives (DFID, 1999). It refers to financial resources available to households (such as cash, savings, credit, and regular remittance and pensions) which enable them access to and pursue on various livelihood options (Carney 1998). It is the most versatile asset which can easily be converted into other forms of capitals and enable households directly achieve their desirable livelihood outcomes. Yet, it is also the least available asset to the poor (DFID, 1999).

2.4.2. Vulnerability Context

In the disaster management literature, the question “vulnerability to what” is usually answered by specifying an external hazard (threat) that can lead to an undesirable outcome i.e. disaster (Dilley and Boudreau, 2001). Sen (1981a), however, challenged the conception that droughts and floods are the principal causes of famine. Vulnerability of a nation to natural hazards and shocks may not necessarily lead to a negative outcome. Downing (1991) refined that defining vulnerability in reference to a cause indicates a negative consequence without completing the reference. Downing asserts that nations are vulnerable to drought implies a causal linkage between drought and an unspecified negative impact. The vulnerability context refers to not only a cause but also to a consequence (Dilley and Boudreau, 2001). Dilley and Boudreau note that the definition of vulnerability in reference to the cause underpins that analysts must first identify the likely shocks, exposed groups and their degrees of susceptibility, and the likely impacts. Likewise, the outcome-oriented definition of vulnerability constitutes external causal factors, susceptibility to them and defenselessness.

Food security is an ex-post measure of household decision making (Alinovi, Mane and Romano, 2009). It reflects the current state of basic needs deprivation. Vulnerable is universally referring to the undesirable livelihood outcomes that vulnerable populations face (Dilley and Boudreau, 2001). Vulnerability context constitutes an external side of risks, shocks and stresses to which an individual or a household is subject to and an internal side which is defenselessness

or lack of means to cope without damaging loss (Chambers, 1989). It donates to the exposure to harmful events and to a specific negative outcome (Lovendal and Knowles, 2005).

Households have assets at their disposal to make a livelihood (Dercon, 2001). In fact, a mere access to assets may not lead them to desirable livelihood outcomes. Household assets and their transformation into income; and the transformation of income into desirable wellbeing are all subject to shocks (Alinovi, Mane and Romano, 2009). Vulnerability in the livelihood framework refers to the external environment in which households exist (Krantz, 2001). This vulnerability context constitutes multitude of factors including biophysical resources, demographic variables, and technological change; shocks and seasonality of production that affect asset endowment and food security of the poor (Scoones, 1998; DFID, 1999; Krantz, 2001). Such contextual factors can destroy assets and exacerbate food insecurity (Degefa, 2005).

2.4.3. Transforming Structures and Processes

This transforming structures and processes component of the framework donate institutions, organizations, polices and legislations that shape livelihoods of households. They determine access to and control over assets; terms of exchange and returns to any investments and livelihood strategies households made to secure food (DFID, 1999). They mediate the context households live in and livelihood strategies they pursue to convert their assets into desirable outcomes. It is here important to clarify the difference between institutions, organizations, social relations, policies and programs within which people access to assets and pursue livelihood strategies. Institutions constitute the social, political, legal and economic systems of a state. They are the “rules of the game” in a society (North, 1990). Policies and programs refer to the state or governing body efforts made to influence the choices and actions of individuals and households towards meeting their desired livelihood objectives (Vaitla et al, 2012).

2.4.4. Livelihood Strategies

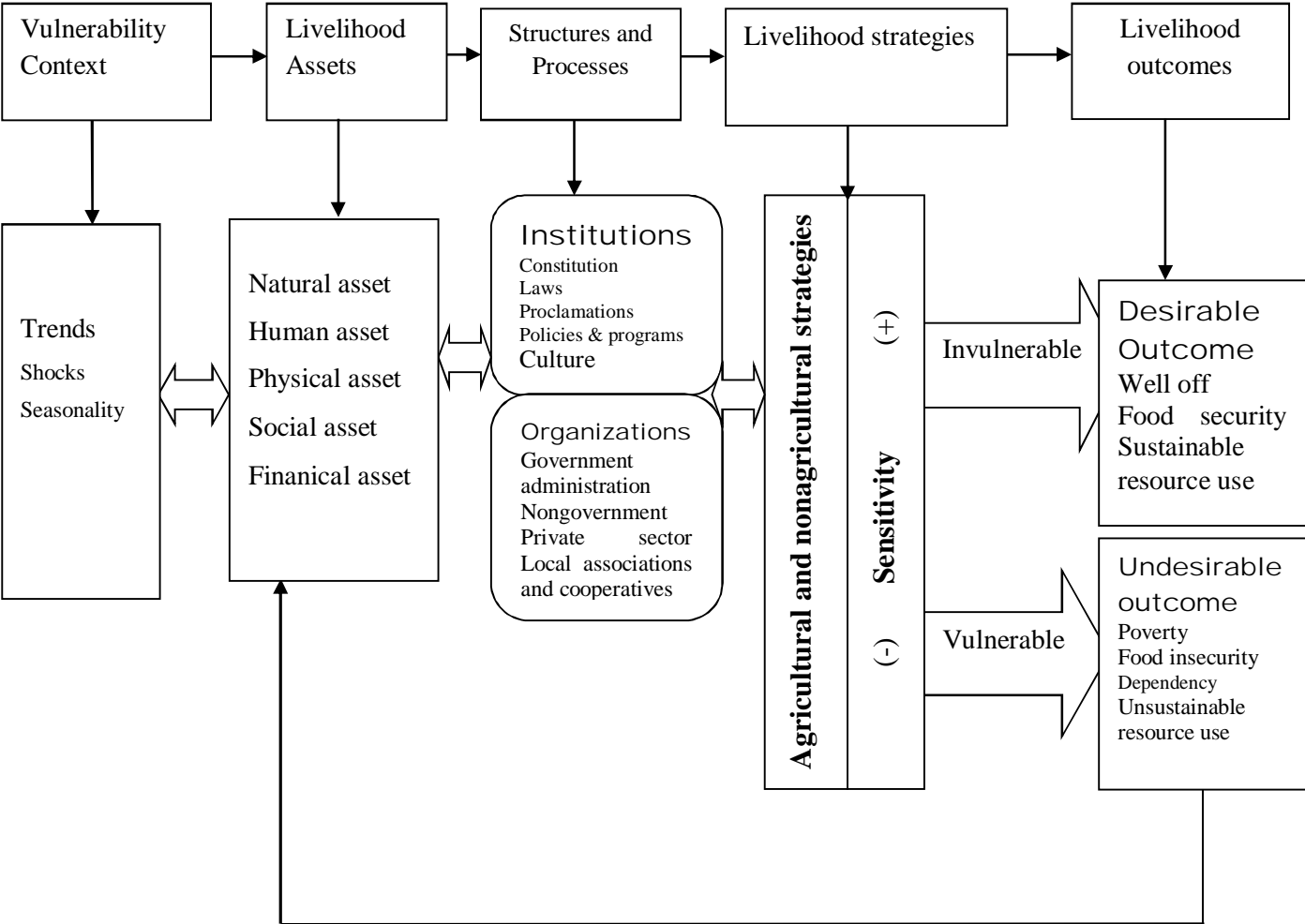
Livelihood strategies refer to any form of activities that generate a means of household living (Ellis, 2000). It has long been wrongly assumed that the poor pursues certain livelihood strategies and activities to meet their livelihood objectives. The livelihood approach seeks to enlarge and diversify livelihood strategies that the poor can pursue (DFID, 1999). It does not restrict households to undertake any livelihood strategies. It rather helps analysts try to

understand factors behind households' choice of livelihood strategies; promotes the positive livelihood outcomes and mitigates the negative ones (DFID, 1999).

2.4.5. Livelihood Outcomes

Livelihood outcomes are ultimate objectives households want to achieve. They are final outputs of livelihood strategies households pursue. They can be either desirable or undesirable (Degefa, 2005). Households pursue various livelihood strategies to achieve desirable livelihood outcomes like increasing income and wellbeing; and reduce poverty and food insecurity. No household pursues any form of livelihood activities and strategies to achieve undesirable livelihood objectives. Yet, the context they live in; their access to assets and the mediating processes may move them in or out of food insecurity.

Figure 1: Sustainable Livelihood Framework



Source: DFID (1999 and 2011)

2.5. Resilience of Households to Food Insecurity

Resilience is a fuzzy concept that can neither be clearly comprehended nor quantified (Constas et al., 2016; Università di Roma, 2015; FAO, 2016); many have confused what exactly it means (Mitchell, 2013; Davoudi, 2012). It comprises different connotations to different people who have different disciplinary backgrounds (Martin and Sunley, 2015). Béné (2013) underscores that most approaches, tools and methods proposed to measure resilience reflect the diversity of disciplines and sectors that have appropriated the term. The IFPRI (see Stein, 2013: annex) and RAU (2015: annex) of FAO have compiled the vast definitions of resilience scattered here and there in the literature.

The concept of resilience was originally described in the ecological literature (Holling, 1973). It has two variants: engineering and ecological (Holling, 1996). The concept of resilience in engineering refers to the ability of a system to return to the steady state after a perturbation (Tilman and Downing, 1994). In the ecological literature, resilience refers to the magnitude of disturbance that a system can absorb before it redefines its structure and adapts to the new condition created by the disturbance (Holling, 1973). Engineers try to make structures work while ecologists acknowledge that ecosystems can break down and change their behavior. Both disciplines focus on the capacity of a system to sustain in an uncertain world (Alinovi, Mane and Romano, 2009). Resilience in economics has long referred to the single (or stable) equilibrium where supply and demand meet. Such single equilibrium belief of economists has already perished and they began to recognize the existence of multiple stable states. Resilience in economics hence refers to the ability of a system to maintain optimum production on a sustainable manner in a changing world.

Determination of resilience level has context, disturbance, capacity and reaction elements (DFID, 2011). Resilience should always be clearly contextualized and defined to a specific social unit/system. It must fix the question of 'resilience of what? The disturbance component addresses the question 'resilience to what' by specifying natural or manmade shocks or stresses. The reaction to disturbance refers to the extent to which the social unit bounces back to a better, normal, worse state or completely collapse (DFID, 2011). Resilience of households to food insecurity here denotes to the ability of those households to maintain a certain level of food security to withstand shocks and stresses. This food crises resilience capacity of households at a given point in time depends primarily on the (livelihood) options available to them to make a

living and on their ability to handle risks (Alinovi, et al., 2010). It constitutes ex-ante actions aimed at reducing or mitigating risks, and ex-post actions to cope with those risks. It also covers both short-term actions and long-term actions (Alinovi, Mane and Romano, 2009).

2.5.1. Principles of Resilience Measurement

Resilience of households to food insecurity has initially been empirically tested in Palestine (Alinovi, Mane and Romano, 2009). It has since then attracted the attention of contemporary scholars in the food security literature (Ciani and Romano, 2013, Maxwell et al., 2013 and Smith et al., 2014). The authors define resilience as a latent variable made up of multiple components. In fact, each component is also a latent variable that cannot be observed directly (Alinovi, Mane and Romano, 2009). The following principles of resilience measurement guided and informed the researcher to estimate food crises resilience capacity of households (Constas et al., 2014a; and IGAD, 2015) in the area.

Resilience is a normatively indexed capacity: resilience must be understood in terms of absorptive, adaptive and transformative capacities that should be indexed to a given development outcome with a normative threshold. The outcome of interest should include a normative boundary that defines a threshold condition below which the well-being of an individual, household, or community is unacceptable. The inclusion of a normatively defined minimum threshold condition ensures that resilience is viewed as a capacity that enables households and communities to function in the face of shocks and stresses.

Subjective states and qualitative data: subjective measures of resilience are important because they provide empirical access to perception-based indicators. The implicit assumption that resilience is a response to shocks highlights the need to collect subjective qualitative data. The local context of food security perceptions also calls for the use of qualitative indicators alongside quantitative indicators. It is measured through the integration of quantitative and qualitative methods; and objective and subjective measures (Constas et al., 2016).

Systems and Complex Causality: Resilience measurement requires modeling of an outcome of interest to a series of parameters that affect well-being and their interactions. Both qualitative and quantitative data served a valuable function in the effort to understand resilience capacity and map the influence of it on a social system.

Shocks and Stress Specificity: Resilience analysis begins by contextual analysis of trends, shocks and seasonality (FAO, 2015). It measures should be sensitive to the specific types of shocks that threaten household food security.

Desirable and Undesirable Equilibrium: resilience measures should contain indicators that help analysts identify those instances when the return to a prior state is desirable and undesirable. The bounce-back feature of resilience is always common point of departure in the resilience literature. This is because returning to a prior state could be desirable or not for some elements of a system of interconnected conditions that affect food security.

Inherent Volatility and Instability: Resilience must be understood over a significant time frame of reference (or longitudinal data) that show the interaction between shocks, household responses and their resilience capacity to food insecurity. Resilience measurement tools must be sensitive enough to detect the existence and effects of inherently unstable components of resilience and food security. Hence, resilience measures and analytical methods should be structured to detect and measure such volatility. Yet, resilience measurement is flexible that can be adapted based on the context, available data and objectives of the study being undertaken.

Multiple Scales and Multi-level Interactions: resilience is a multi-scalar concept. It is influenced by the interactions of different processes at different levels and scales. It is a capacity that can be measured at individual, household, community, and national levels. Yet, empirical evidences show that measuring resilience at household level addresses the question of measurement scale of resilience.

Rates of Change and Timing of Measurement: The data collection period to measure resilience of households to food insecurity matters. It should not be collected arbitrary at any time T. The data collection period should be determined according to knowledge of expected rates of change for both the outcome of interest and the factors that influence those outcomes.

Resilience vis-à-vis Vulnerability Connections: The concept of resilience is similar with but not synonymous to vulnerability. Resilience refers to the ability of an individual, a household, a community, or an institution to bounce back and persist in chronically vulnerable or food insecure areas of the world (Vaitla et al., 2013 and Maxwell et al., 2013). It concerns with the various ways a household, community and system prepares for and responds to shocks and stresses that threaten their wellbeing. Resilience is a measure of stability in the face of

shocks to the social system. It represents a set of resources and capabilities that a social system can use to prepare for and respond to shocks and stresses (Constas et al., 2014b).

Vulnerability is the flip side of resilience. It is the ability or inability of households to respond to, cope with, recover from, or adapt to, any external stress placed on their livelihoods and wellbeing (Kelly and Adger, 2000, cited in Belay et al., 2014). Vulnerability measures the resilience against a shock (World Bank, 2001). When a system loses resilience it becomes vulnerable to change that could be absorbed (Kasperson and Kasperson, 2005). Resilience in the food security literature intends to measure the capability of households to absorb the adverse effects of unpredictable shocks, rather than predicting the occurrence of a crisis like vulnerability (Alinovi, Mane and Romano, 2009). Yet, both of them share a common set of parameters such as shocks and stresses to which a social system is exposed to; and the response and adaptive capacity of the system. Nevertheless, vulnerability analysis often tends to measure the susceptibility of a social system to harm and the coping strategies it immediately adopts (Alinovi, et al., 2010). Resilience measures should build on the vulnerability literature and existing measures of it. It should also build on coping strategy measures households take.

Heterogeneity Interpreting Tools: the ability to explain heterogeneous effects of vulnerability conditions that lead to food insecurity represents one of the key challenges of measurement and analysis. The ability to measure resilience should facilitate efforts to explain heterogeneous response to shocks and stresses observed in households and communities with different and similar levels of vulnerability. Measures of resilience should therefore assess the way in which resilience capacities mediate the consequences of shocks.

2.6. Empirical Literature

There is rich empirical literature on food security. Exhaustive review of the empirical food security literature is not only a very tall order but also meaningless. This review is indeed limited to food crises resilience empirical works. Resilience is an abstract capacity composed of various components (FAO, 2016). Research on food crises resilience capacity estimation is an emerging trial to understand the real resilience capacity of households. It has introduced to food security literature in 2008 (Alinovi et al., 2009). Since then, resilience studies focus on conceptualizing food crises resilience and measurement issues of it (See Béné, 2012; Béné, 2013; Constas et al., 2014a; Constas et al., 2014b; Alfani et al., 2015; Constas et al., 2016).

Resilience study captures both the static and dynamic capacity of households to undesirable livelihood outcomes. The limited empirical studies are categorically divided into direct (descriptive) and indirect (inferential) food crises resilience analysis. The direct (descriptive) approach tries to measure the current resilience capacity of households to food insecurity at a specific moment in time. It uses a series of observable variables to compute resilience index through complexity reduction multivariate techniques. It intends to describe both resilience capacity and resilience structure. The basic intent of it is ranking and targeting of households.

The indirect (or inferential) approach intends to measure and fix the main determinants of resilience. It uses longitudinal dataset to explore the dynamics of resilience capacity of households to undesirable livelihood outcomes over time. It proposes an indirect measure of resilience that adopts regression analysis and, consequently, allows causal inference. In fact, some scholars handle both resilience measurement and its determinants together while others treat them separately. However, the distinction between resilience capacity measurement and fixation of its determinants is always vague and difficult to justify (Ciani and Romano, 2013).

The empirical studies made by Alinovi et al. (2009), Alinovi et al. (2010), Vaitla et al. (2013), Smith et al. (2015), Smith and Frankenberger (2015), and IGAD (2015) measured resilience of households to food insecurity using longitudinal dataset. Alinovi et al. (2009) have introduced to and empirically tested resilience of households to food insecurity in Gaza using the 11th Palestinian Public Perception Survey. They measured it using income and food access; assets; access to public services; social safety nets, stability, and adaptive capacity indicators. They found interesting results and recommended to replicate such studies in other contexts. Alinovi et al. (2010) is the second most important empirical resilience study carried out in Kenya. They used an updated version of the resilience analysis framework made by Alinovi et al. (2009) and measure it using income and food access, agricultural asset, nonagricultural asset, agricultural practice and technology, access to basic services, social safety-nets, stability, and adaptive capacity. Using longitudinal Kenyan Integrated Household Budget Survey (2005-06) dataset, Alinovi et al. (2010) differentiated the resilient and less resilient households in Kenya and fixed the determinants of resilience capacity across provinces and livelihood groups in the country. Vaitla et al. (2013) tracked livelihood dynamics over time in Eastern and Southern Tigray. They considered resilience as one component of their study, instead of measuring it directly. Vaitla et

al. (2013) found a puzzling picture. The food security indicators depicted improving access to food but not a corresponding improvement in livelihood asset accumulation.

Similarly, Smith et al. (2015) and Smith and Frankenberger (2015) conducted an evaluative resilience capacity of households to shocks and negative livelihood outcomes in pastoralist drylands of Ethiopia. Smith et al. (2015) was a baseline study of the pastoralist areas resilience improvement and market expansion project while Smith and Frankenberger (2015) was an impact study of it. Smith et al. (2015) and Smith and Frankenberger (2015) measured resilience capacity of pastoralists using absorptive capacity, adaptive capacity, and transformative capacity indicators. These two resilience analysis confirmed that the more severely households were exposed to the drought, the less likely they were to recover from it and hence the less resilient they were. They demonstrated that only about one-third of households were resilient to the first wave of shocks. Pastoralists were less likely to be resilient than agro-pastoralists, and agro-pastoralists were less likely to be resilient than non-pastoralists. The majority of households in the dry land pastoral areas of the country were not able to maintain their food security in the face of the drought. The absorptive, adaptive and transformative capacities of households did buffer them from the shock.

The resilience analysis unit of IGAD (2015) carried out resilience of households to food insecurity and malnutrition to better understand their resilience capacity to such negative livelihood outcomes in Karamoja, Uganda. IGAD measured resilience capacity of the households using absorptive capacity, adaptive capacity, and transformative capacity indicators. This study categorized the households into resilient and non-resilient based on (1) food security score—households with an acceptable food consumption score; and (2) no malnourished children—households where no child was wasted, stunted or underweight based on weight-for-height, weight-for-age and height-for-age scores. FAO, UNCIF and WFP (2014) and FAO (2015) carried out an evaluative empirical study to estimate resilience capacity of Somali households to negative livelihood outcomes using cross-sectional data demonstrated that ‘at risk households anticipate, resist, absorb and recover quickly from pressures and shocks’. They confirmed that development programs in Somalia have positive impact on resilience capacity enhancement whereby households in program area (Dolow) had more opportunities to diversify their livelihoods than the population in nonintervention areas. Similarly, Adane (2018) conducted a PhD research on resilience of rural households to food insecurity in Southern

Ethiopia using cross-sectional data. Adane estimated food crises resilience capacity of households using agricultural assets, agricultural technology adoption, and access to basic services, social capital, social safety nets, and adaptive capacity, and income and food access indicators. This study demonstrated that over 60 percent of the surveyed households in the region are non-resilient to food insecurity but vary based on the livelihood zone.

This study follows similar approaches to measure food crises resilience of households. It, however, differs from the aforementioned empirical works (1) made an exhaustive analysis of livelihood asset endowments; (2) used multidimensional food security indicator to estimate food security status of households in totality; and (3) used an updated version of the resilience analysis framework.

Table 1: Summary of empirical works on resilience of households to food insecurity

Author	Location	Resilience indicators	Methodology	Finding
Alinovi et al. (2009)	Palestine	Food access, assets, access to public services, social safety nets, stability and adaptive capacity	Multivariate analysis Structural equation	<ul style="list-style-type: none"> • Food insecurity enhances social solidarity/adaptation • Regional resilience differences
Alinovi et al. (2010)	Kenya	Food access, agricultural asset, nonagricultural asset, agricultural practice and technology, basic services, social safety-nets, stability/ adaptive capacity	<ul style="list-style-type: none"> • Cluster analysis • Factor analysis 	Resilience difference between livelihood subgroups
Vaitla et al. (2013)	Tigray	CSI, HFIAS, HHS, FCS, SAFS, illness score, asset/net debt, and income absorptive capacity, adaptive capacity, and transformative capacity	<ul style="list-style-type: none"> • Descriptive • Bivariate analysis 	Divergence between food access livelihood asset accumulation
Smith et al. (2015)	Pastoralist areas in Ethiopia	absorptive capacity, adaptive capacity, and transformative capacity	<ul style="list-style-type: none"> • Descriptive • PCA/Polychoric • Regression 	Divergence between poverty, shock exposure and resilience ability
Smith and Frankenberger (2015)	Pastoralist areas in Ethiopia	absorptive capacity, adaptive capacity, and transformative capacity	<ul style="list-style-type: none"> • Descriptive • PCA/Polychoric • Regression 	Absorptive/adaptive/transformative capacities buffer food security of households but not that enough
IGAD (2015)	Uganda	absorptive, adaptive and transformative capacities	Descriptive	Characterizing resilience capacities of households
FAO, UNCIF & WFP (2014); FAO (2015)	Somalia	Productive assets, basic services/social safety nets, sensitivity/adaptive capacity	Descriptive Difference in Difference	Development programs and aids enhance resilience capacity of households
Adane (2018)	Southern Ethiopia	Food access, agricultural assets/agricultural technology, basic services/ social safety nets/adaptive	<ul style="list-style-type: none"> • Descriptive • PCA analysis 	Food crises resilience varies based on livelihood zone

2.7. Conceptual Framework of the Study

In this chapter, the researcher made a comprehensive review of development theories and approaches underpinning food security in their chronological order. He also reviewed the emerging resilience concept and its application in the food security literature. Each theory and approach underpins food security. Yet, it is important to note that each theory and approach cannot equally explain the causes of food insecurity. It is thus possible to conclude that the study requires a general analytical framework which integrates the sustainable livelihood and resilience approaches to food security. The framework constitutes important variables from each theory and links them with one another. In statistical terms, this review of the literature has shown that the study demands huge (unmanageable) data. The researcher, therefore, used a mixed methodology and multivariate techniques to collect and identify the key variables and examine the relationship therein between the variables.

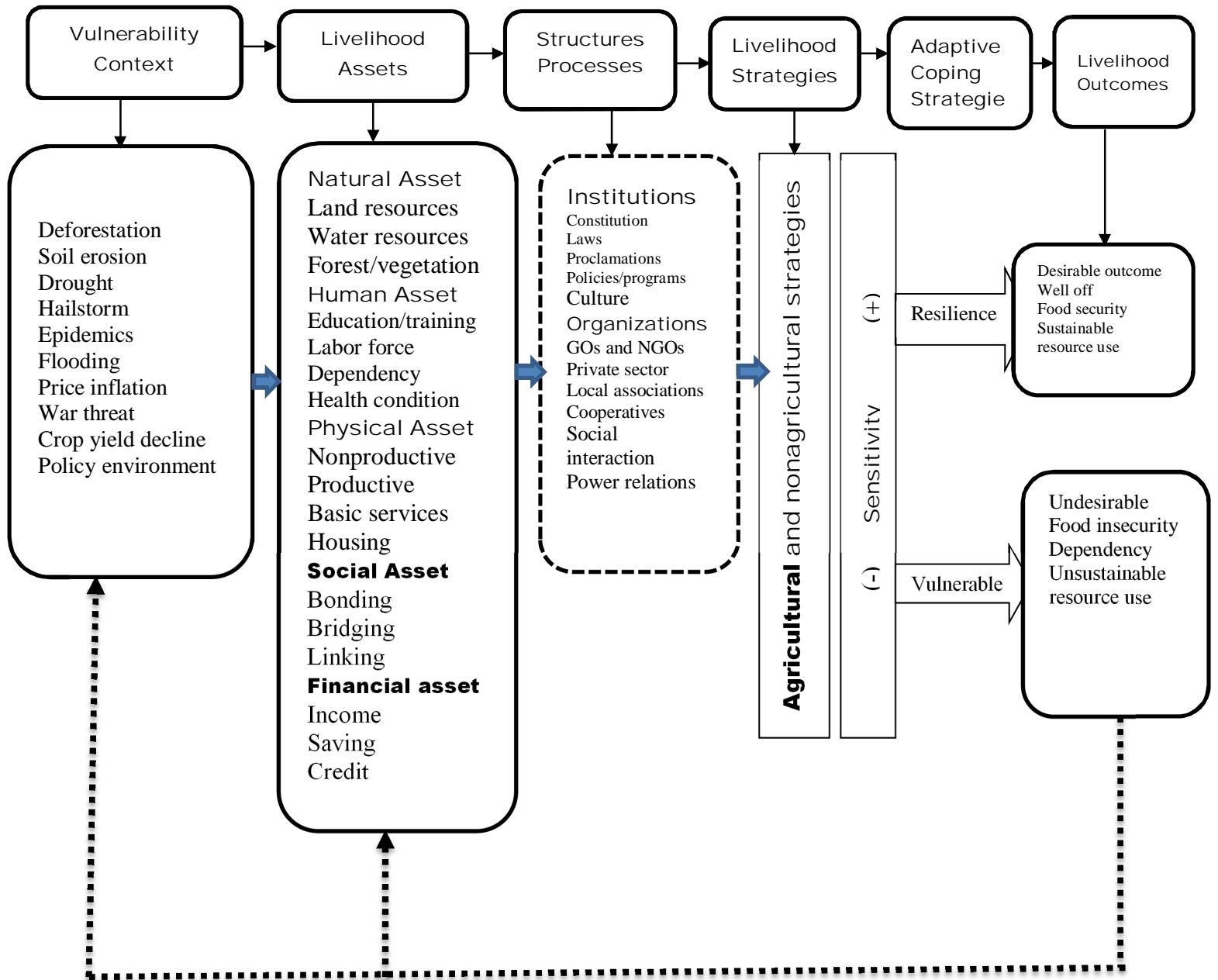
A number of conceptual frameworks are circulating in the literature to measure resilience of a social system to a given development outcome (or food insecurity of households) (see Conostas et al., 2014b: annex). The resilience frameworks build on SLF and share a number of common components with it. This research studies resilience of households to food insecurity in livelihood perspectives and amalgamates the SLF (DFID, 1999) with DFID (2011) resilience framework to measure resilience capacity of households to withstand food insecurity in uncertain world. The integrated framework emphasizes the necessity of stability, absorptive, adaptive and transformative capacities of households which heavily rely on their access to and control over assets mediated by shocks, institutional structures and government policies to pursue certain strategies to reduce food insecurity. In other words, building resilience of households requires improving their livelihood stability, absorptive, adaptive and transformative capacities which reinforce one another and exist at multiple levels (DFID, 2011).

The conceptual framework constitutes the main components (boxes) and variables that affect resilience capacity of rural households to food insecurity. Yet, complete analysis of all components and variables of the framework at a time is practically impossible and beyond the scope of this study. This study, instead, focuses on selective components (and variables) such as vulnerability context (shocks and seasonality), assets, institutions and organization (access to

basic services and infrastructures), social safety-nets and food security which intrinsically affect the resilience capacity of a given household.

This study hypothesizes that each component in the framework reinforce one another and each variable also reinforces the other either positively or negatively. A positive interaction between each variable helps households to achieve desirable livelihood outcome while a negative linkage leads them to undesirable outcome. For example, the vulnerability context in which people live in affects resilience capacity (assets) and livelihood outcome (food security) of households and vice versa. This vulnerability context in which households have little control over affects their asset endowment positively and yields a desirable livelihood outcome (food security). Asset endowment of households also enhances their resilience capacity to food insecurity. In other words, asset rich households can easily cope with and respond to shocks. Conversely, pervasive food insecurity degrades asset endowment of households and exacerbates vulnerability. Unless managed, shocks and seasonality also degrade asset endowment of households leading them to vulnerability. The institutions and organizations also mediate the conversion of livelihood assets into outcomes. This study thus tried to investigate and measure the relationship between each variables and how they affect resilience of households to food insecurity.

Figure 2: Conceptual Framework of the Study



Source: Adopted from Degefa (2005), DFID (2009 and 2011)

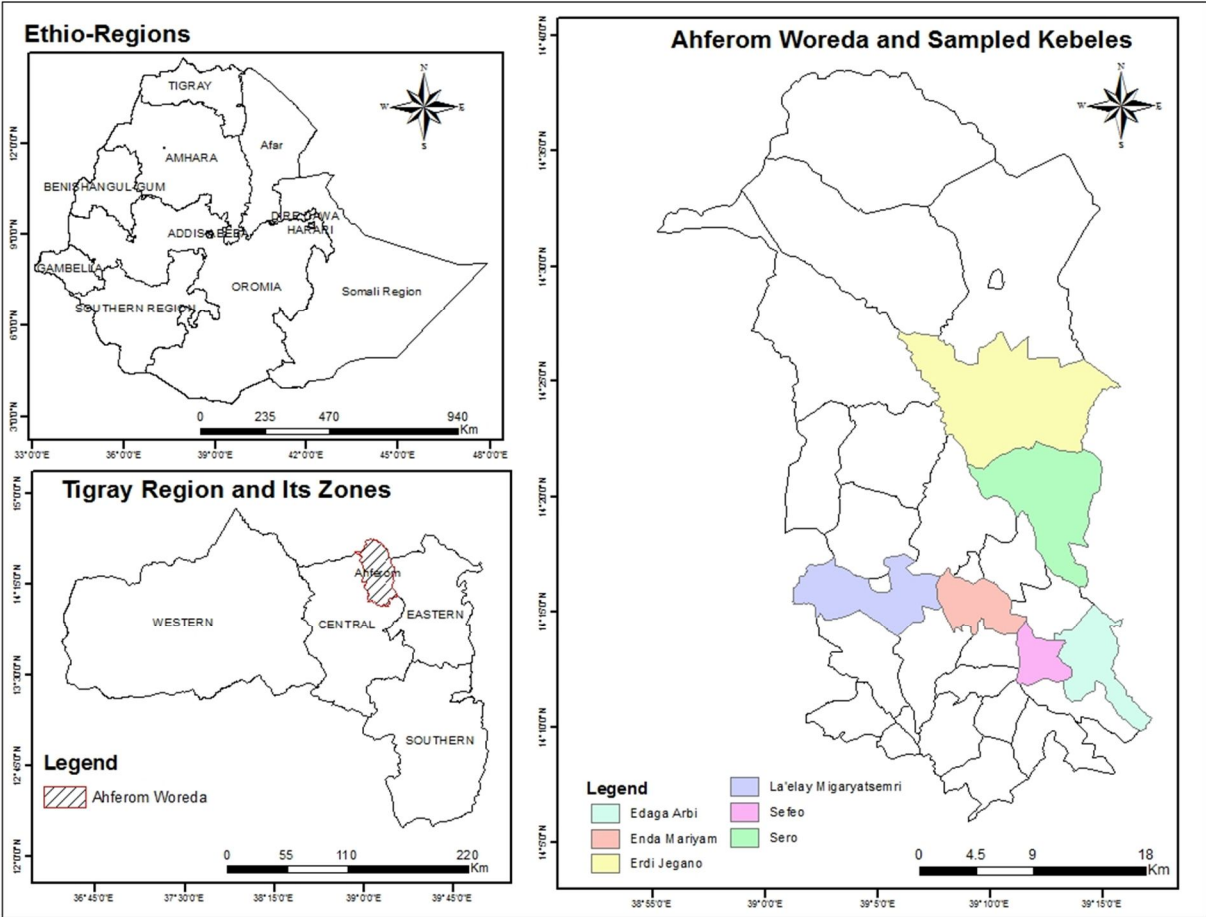
3. METHODOLOGY

3.1. Description of the study area

Ahferom *Wereda* is situated in the central zone of Tigray national regional state. The *Wereda* is located at 189 and 967 kilometers from Meke`lle and Addis Ababa respectively. Geographically, Ahferom *Wereda* is located between 14⁰06'30'' and 14⁰38'30'' latitude north and 38⁰56'30'' and 39⁰18' longitude East (WARDO, 2010). The *Wereda* covers a total area of 133979 hectare (or 1339.79 meter square) comprising different land uses. It is bounded by Eritrea in the north, *Werie-Leke* in south, *Ganta Afeshum* in the east; and Adwa in the west. The population of the *Wereda* doubles every quarter of a century (USAID, 2000). The total population of the *Wereda* was 173651 in 2007 (CSA, 2008). The total population of the *Wereda* is estimated to be 206993 where 100088 and 106905 are males and females respectively. The *Wereda* is divided into 27 rural and 6 urban administrative Tabias (hereafter called *Kebeles*) (WARDO, 2010). Smallholder agriculture is the dominant livelihood activity of the households in the *Wereda* (MOARD, 2009). However, cultivable land is very scarce resource in the area. The average land holding size of a household was 0.5 hectare while the average family size was five (WARDO, 2010).

The *Wereda* does have highland, midland and lowland distinctive agro-ecologies. The midland agro-ecological zone ranging from 1500 meters above sea level to 2300 meters above sea level covers 56.7 percent of the *Wereda* while the lowland agro-ecological zone with an elevation of 500 meters above sea level to 1500 meters above sea level covers 38 percent of the area. The rest 5 percent of the area is characterized by highland agro-ecological zone ranging from 2300 meters above sea level to 3200 meter above sea level. Likewise, 17, 10 and 6 of the administrative *Kebeles* are located in the midland, highland and lowland agro-ecological zones of the *Wereda*, respectively (WARDO, 2010). Rainfall usually occurs once in a year in the *Wereda*. This rainy season extends from mid-June to mid-September where 80% of it concentrates in July and beginning of August. The *Wereda* receives 540 to 650 millimeter rainfall during the summer season with an average annual rainfall of 733 millimeter (WARDO, 2010; and Gebrewahd, 2014). The average temperature of the *Wereda* is 27⁰ c, ranging from 21⁰c to 30⁰c. Moreover, the *Wereda* has long been prone to and affected by natural and manmade shocks and stresses. Drought, famine, epidemics and the subsequent civil war have been adversely affecting the livelihood of the poor (USAID, 2000 and MOARD, 2009).

Figure 3: Ahferom Wereda Administration Map



Source: Ethio GIS and CSA (2007)

3.2. Research Design

Resilience measurement requires longitudinal data in order to investigate how households cope with and respond to food insecurity overtime. However, the concept of resilience has introduced to food security studies only in 2008 and hence it is difficult to get longitudinal data applicable to the study area. This study employed cross-sectional survey research design where different data at a point in time were collected. The design is a single episode of a fieldwork because it focuses on current resilience capacity of households to withstand food crises.

3.2.1. Research Philosophy

There are a number of paradigms in social science studies each of which advocates different methodologies and methods to construct social reality and knowledge. It is important to differentiate the philosophical underpinning that governs the researcher to measure food crises resilience analysis. Let's now highlight the dominant research philosophies and their ontological and epistemological positions in order to fix the paradigm that guided the researcher in the research process.

The Positivist paradigm which has long been dominated the research processes in all disciplines claims (Ryan, 2006) that using scientific method and language to investigate and write about human experience is supposed to keep the research free of the values, passions, politics and ideology of the researcher. Positivism believes that researchers can reach a full understanding based on experimentation and observation. It holds a deterministic philosophy in which causes determine effects or outcomes. It reduces the array of ideas into a small and discrete set of manageable variable to test the hypotheses and research questions (Creswell, 2009). This paradigm further holds that there are laws or theories that govern the world and these need to be tested or verified and refined in order to understand the world. Positivism maintains that the scientist is the observer of an objective reality. Scientific inquiry under this paradigm intends to prove or disprove a hypothesis (Mackenzie and Knipe, 2006). The existence of independent, predictable and objective reality is the ontological position of positivism while deductive reasoning, attainable truth and objectivity of knowledge are the epistemological position of the paradigm (Mack, 2010). The paradigm advocates the traditional quantitative research which uses scientific methodology and statistical analysis to draw generalizations. However, it has a number of limitations especially in the social science studies. The opponents of the paradigm

argue that uniform causal links that can be established in the study of natural science cannot be made on human affairs. The absence of neutral knowledge; inadequacies of dualistic thinking, ethical dilemma of research; and complexity of science has challenged the dominance of the scientific paradigm (Ryan, 2006) which led to the emergence of Post-positivism in the aftermath of the second World War. Like positivists, post-positivists try to draw generalization, seek to understand causal relationships by experimentation and correlation studies; however, they believe that the researcher and the researched are not independent of one another. Post-positivism has similar ontological and epistemological beliefs as positivism (Scotland, 2012) but the former paradigm believes that knowledge is a result of social conditioning (Wahyuni, 2012). It is tentative; hypotheses are not proved but simply not rejected (Creswell, 2009). The post-positivistic paradigm assumes that research cannot be value free and unbiased but be value-laden, subjective and inter-subjective, even value-driven within the critical paradigm (Wahyuni, 2012).

The constructivism paradigm which can also be called “anti-positivism” was developed as a reaction to the positivism. The paradigm emphasizes on the ability of the individual to construct meaning (Mack, 2010). The ontological position of constructivism is relativism (Scotland, 2012). It assumes that social reality is seen by multiple people and these multiple people interpret events differently leaving multiple perspectives of an incident (Mack, 2010). Constructivists believe that research can never be objectively observed from the outside rather it must be observed from inside through the direct experience of the people. Uniform causal links that can be established in the study of natural science cannot be made in the study of social sciences where human beings construct meaning. Thus, the role of the researcher is to “understand, explain, and demystify social reality through the eyes of different participants” (Cohen et al., 2007).

However, neither the positivism/post-positivism nor the constructivism paradigm underpins resilience analysis in the food security literature which requires a combination of quantitative and qualitative data. The research philosophy literature reveals that the pragmatism paradigm underpins to and provides vast opportunity to use mixed research methods. Pragmatism research philosophy refuses to join the ‘paradigm war’ between the positivist and constructivism research philosophies (Tashakkori and Teddlie, 1998). Pragmatism is not committed to any one system of philosophy or reality (Creswell, 2009). The proponents of

pragmatism emphasize that one should view research philosophy as a continuum, rather than an option that stands in opposite positions. Pragmatism researchers believe that objectivist and subjectivist perspectives are not mutually exclusive. Hence, a mixture of ontology, epistemology and axiology is acceptable to approach and understand social phenomena. Pragmatism fits to the mixed methods approach and hence pragmatist researchers favor working with both quantitative and qualitative data (Wahyuni, 2012).

Pragmatism places the research problem at the center and applies all approaches to understand the problem. It is problem centered; pluralistic, real world practice oriented and uses mixed models (Creswell, 2009) and prefers actions to philosophy (Johnson and Onwuegbuzie, 2004). Pragmatic researchers are free to choose the methods, techniques, and procedures of research that best meet their needs and purposes. They do not see the world as an absolute unity. Researchers therefore must adopt mixed research approaches to collect and analyze data rather than subscribing to only one way. Research occurs in social, historical, political, and other contexts. Pragmatist researchers open the door to multiple methods, different worldviews and assumptions, and different forms of data collection and analysis (Creswell, 2009). The researcher used mixed methods approach in order to understand the research problem and answer the research questions posed in the first chapter of this thesis.

Qualitative and quantitative research approaches are usually confusing to (junior) researcher by informally referencing to researchers as qualitative or quantitative researchers (Mackenzie and Knipe, 2006). Many text books also consider the qualitative, quantitative and mixed methods as paradigms which further exacerbate the confusion. It is therefore important here to note that the qualitative, quantitative and mixed methods are not theoretical approaches (paradigms) to research. They rather refer to “the data collection methods, analysis and reporting modes” (Mackenzie and Knipe, 2006). Quantitative research approach focuses on deduction, confirmation, theory/hypothesis testing, explanation, prediction, standardized data collection, and statistical analysis (Johnson and Onwuegbuzie, 2004). Conversely, qualitative research is often considered as ‘messing around’, being ‘vague’, not scientific and not following a structured plan (Jonker and Pennink, 2010). It emphasizes on induction, discovery, exploration, theory/hypothesis generation and qualitative analysis (Johnson and Onwuegbuzie, 2004). The quantitative and qualitative research methods have categorically been placed in a continuum

where the former methods anchored at the right end of the continuum while the later methods sitting on the left end of it (Johnson and Onwuegbuzie, 2004) and hence they cannot be blended.

On the other hand, pragmatist researchers advocate mixed methods approach. Mixed methods approach involves induction, deduction and abduction. It is inclusive, pluralistic, and complementary (Johnson and Onwuegbuzie, 2004). It involves gathering both quantitative (numeric) data and qualitative (text) data so that the final database represents both quantitative and qualitative information (Creswell, 2003). It has triangulation, complementation, initiation, development, and expansion comparative advantages over quantitative and qualitative methods. Mixed methods research can either be mixed model designs or mixed method designs where the former mixes quantitative and qualitative approaches within or across the stages of the research process while the later constitutes a quantitative phase and a qualitative phase in an overall research study (Johnson and Onwuegbuzie, 2004). This study adopts a mixed model designs where the qualitative and quantitative data were collected and analyzed concurrently.

3.2.2. Data Type and Source

Both quantitative and qualitative data were used to estimate livelihood asset endowment, multidimensional food security status of households and their resilience to negative livelihood outcomes. The quantitative data on socio-demographic characteristics of the households, livelihood activities/strategies, agricultural production, incomes and expenditure, saving and credit, livelihood assets, market and information access, basic services, multidimensional food security indicator, shock factors, and coping strategies were collected from systematically selected rural households using semi-structured questionnaire. The technical, policy and institutional data were generated through focus group discussion and key informant interviews. The study used both primary and secondary data. The main sources of primary data were sample households, focus group discussants, DAs, and *Kebele* administrators/elders/community figures/women, and experts. The main sources of secondary data were published/unpublished government documents, reports, policy documents, previous studies, books and websites.

3.2.3. Data Collection Methods and Tools

This study employed multiple data collection tools to gather primary data on socioeconomic and demographic data, livelihood activities/strategies, food security indicator variables, livelihood assets, agricultural technologies, basic services, social safety nets, shocks and stresses, stability,

adaptability, absorptive and transformative variables of the study. The multiple tools were combinations of different tools and tactics within the same study design (Bloor and Wood, 2006). Semi-structured questionnaire, FGD guide and KII checklist were used to gather the primary data. The secondary data were gathered from books, journal articles, policy papers, dissertations and other published/unpublished documents of government and nongovernmental organizations. The following sections describe the data collection tools in detail.

3.2.3.1. Questionnaire

Road networks, literacy and communication facilities are poor in rural Ethiopia. Hence, it is difficult, if not impossible, to use self-administered questionnaire to collect household survey data. Hence, semi-structured questionnaire was prepared in English and translated into Tigrigna to gather primary data from systematically selected respondents. The questionnaire constituted close-ended and open-ended questions. It was administered to household heads. A total of twenty four enumerators were recruited based on their educational background, knowledge of Tigrigna language, and familiarity with the culture of the community and work experience in the area to collect the primary data. The researcher provided three days training to the enumerators on code of conduct for data collection, survey objectives, interview approaches and survey data collection techniques and tools. The questionnaire was pre-tested and subsequently modified to suit the intended purpose of the study before the actual data collection was begun. One supervisor was assigned in each *Kebele* to inform the selected households in advance of the survey time and made sure that they are willing to and available for the interview.

3.2.3.2. Focus Group Discussion (FGD)

FGD was used to generate additional information from purposively selected women groups, development agents, and community figures and/or elders. One FGD was held in each sample *Kebele*. Each FGD was comprised of 8-10 participants selected on the bases of their knowledge about and experience in natural and manmade shock factors, resource endowment of the locality and trend in food security. The principal researcher prepared unstructured discussion guideline to instigate the discussions and generate further information. The researcher facilitated the discussions in each *Kebele*. The participants of the discussion were heterogeneous.

3.2.3.3. Key Informant Interview (KII)

KII was held with government agents and experts (of Ahferom *Wereda* administration, rural development and agricultural office, water, energy and mining office, education office, health

office, disaster prevention and preparedness office) to generate technical information related to development policy environment, basic services and social amenities provision, infrastructure, historical trends of shocks and food shortages, institutional and technological constraints and opportunities the households and communities face in the *Wereda*. The key informants were selected based on their disproportionate knowledge about and experience on national and regional food security strategies and programs, public sector leadership experience, PSNPs, regional and local disaster prevention and preparedness, institutional and technological constraints and opportunities the households and communities face in the *Wereda*. The principal researcher prepared unstructured KII guide to prompt the interview. A total of 12 interviews were held with resourceful experts purposely selected from agriculture and livestock office, PSNPs, Disaster Prevention and Preparedness, Water and Energy, Education, and Health office of the *Wereda* to generate technical information on the subject under scrutiny. Data obtained from such key informants were used to substantiate the quantitative data findings of the study.

3.2.4. Sampling and Sample Size Determination

This section presents the sampling procedure and sample size determination of the study. There is no doubt that census provides the highest accuracy in any inquiry. However, a complete enumeration of all items in the population is not only practically impossible but also it requires a great deal of time, money and energy usually beyond the researcher. Perhaps, government is the only institution which can carry out complete enumeration (Kothari, 2004). The study collected the primary data from selected households. Kothari notes that the sample must be representative of the total population in order to produce a miniature cross-section.

The study adopts a multi-stage stratified random sampling technique. In the first stage, *Ahferom Wereda* is selected purposively because of the pervasive poverty and food insecurity, recurrent drought, epidemics, protracted civil wars and conflicts. In the second stage, among 27 rural *Kebeles* of *Ahferom Wereda*, a total of 6 *Kebeles* (2, 3 and 1 *Kebeles* from highland, midland and lowland agro-ecologies) were selected using proportionate random sampling to size for data enumeration. The study lastly selected sample households using systematic random sampling with random start. The actual sampling went through the following procedure. First, the sampling frame was obtained from each respective *Kebele* administration. The researcher then consulted the *Kebele* administrative bodies and arranged the households alphabetically. The researcher finally calculated the sampling interval (K) by dividing the total population (N) to the

sample size n (i.e. N/n) and took a household at random from the first K households and every K^{th} households thereafter.

How big a sample should investigators take is an important concern in research (Naing et al., 2006). This is because inadequate or excessive sample size deteriorates the quality and accuracy of a research (Bartlett, Kotrlik and Higgins, 2001). In fact, sample size should be neither excessively large nor too small. It should be optimum (Kothari, 2004). The purpose of the study, population size, the level of precision (or sampling error), the level of confidence or risk, and the degree of variability in the attributes being measured are used to decide how large the sample size of a study should be (Israel, 2013). Authors like Kothari also adds that the type of research design, characteristic of the population of interest, the parameters of interest, accuracy of the measurement tools, budget and resource availability affect the size of the sample.

A number of sample size determination formulas are circulating in the literature. This study used Cochran's (1977) sample size determination formula ($n = Z^2 pq/d^2$) to calculate the total sample size where n is the desired sample size; Z is standard normal variable at the required confidence level (Z statistics: 1.96) or the abscissa of the normal curve that cuts off an area α at the tails ($1 - \alpha$ equals the desired confidence level); d is the desired level of precision or level of statistical significance/margin of error the researcher wills to accept (0.05); p is estimated characteristic of target population [variability of population parameters) the researcher assumes which usually equals to 0.5; and q is $1-p$ ($1-0.5=0.5$). The total sample size of the study was thus equal to $n = (1.96)^2(0.5)(0.5)/(0.05)^2 = 384$. This Cochran's sample size determination formulae is valid if the calculated sample size is smaller than or equal to 5% of the target population of the study (or $n/N \leq 0.05$) (Daniel, 1999). In other words, researchers are advised not to apply sample size correction (or reduction) formula if the calculated sample size of their study is below 5% of the total population. Fortunately, the calculated sample size of the study is below 5% of the study population and hence the researcher did not need to reduce the calculated sample size. This 384 calculated sample size is the minimum sample size below which it would not represent the target population nor meets the desired precision the researcher assumes.

However, household surveys often have non-sampling (non-response) errors due mainly to defective definitions of important variables, failure to and bias of respondents to response, coverage and compiling error of the researchers. Researchers are advised to oversample by 10% to 20% of the computed number of samples based on their anticipation of such discrepancies

(Naing et al., 2006). This study anticipated that 90% of the survey questionnaire could be properly filled in by enumerators and returned to the researcher back. That is, he anticipated 10% discrepancies. The final sample size of the study was thus calculated as follows:

$$\text{Final Sample Size} = \frac{\text{Minimum Sample Size}}{\text{Sample Size Adjusted for Response Rate}} = \frac{384}{0.90} = 427 \text{ Households} \dots\dots 3.1$$

In order to select the actual sample households, the study first stratified the administrative *kebeles* into three strata based on agro-ecological zones. Once it established strata, how many items should be selected from each stratum is an important concern. Kothari advised researchers to use proportional allocation under which the sample size selected from the different strata are kept proportional to the sizes of that stratum. The researcher used Kothari's (2004) proportional sample size allocation formula ($n_i = n \frac{N_i}{N}$) to calculate the size of the sample from each stratum; where n_i represents the sample size of each stratum, n represents the total sample size, N_i represents population size of the i^{th} strata and N represents the total population size. In fact, the number of items selected from each stratum was equal to $n \cdot P_i$ where P_i represents the proportion of population in each stratum i and n represents the total sample size. The researchers have encountered none-sampling errors such as reluctance and absence of interviewee and failure to fully complete the questionnaire. The actual sample size of the study was equal to 400 households.

Table 2: Sample *Kebeles* and households

	Kebeles	Total households			Sample households		
		MHHs	FHHs	Total	MHHs	FHHs	Total
1	Endamariam	522	559	1081	31	11	42
2	Sero	1151	1219	2370	80	16	96
3	Laelay Migaratsemri	895	921	1816	51	19	70
4	Sefeo	583	635	1218	36	11	47
5	Edaga Arbi	799	894	1693	35	31	66
6	Erdi Jeganu	931	1003	1934	51	28	79
	Total	4881	5231	10112	284	116	400

Source: Own sampling

3.2.4. Data Analysis

Quantitative and qualitative methods of data analysis were used to analyze the data gathered from fieldwork. The primary data collected from household respondents through semi-structured questionnaire was first checked for accuracy. Second, the data was coded; entered and cleaned in EPI data software (version 3.1). Thirdly, it was exported to Stata Software Package (version 12) and Excel to carry out data analysis. The quantitative data were analyzed using descriptive and inferential statistics. Multivariate techniques were used to analyze the quantitative data. The technical details of the multivariate statistics are presented in their respective chapters.

To substantiate the quantitative data, qualitative data gathered through FGD guide and KII guide were used. The qualitative data were first organized into similar themes, triangulated against each other, and narrated to substantiate the quantitative data analysis results. The FGD and KII guidelines captured contextual [qualitative] information about asset endowment trend of the locality, shocks households experienced and their resilience capacities to such shocks in order to understand and explain food security. The findings of the qualitative data analysis were used to interpret and supplement the quantitative data results. It was integrated with quantitative findings to provide a more comprehensive and contextually specific picture of asset endowments, food security and resilience capacity of households. The qualitative data gave a live opportunity to the local people to report what has been going on the topic under scrutiny in their own words. Moreover, the findings of the qualitative data provided us useful insight about government policies and programs affecting the resilience capacity of households to food insecurity, asset endowment, basic social service provision, and how social capital and social relations function in the wake of shocks.

4. RURAL LIVELIHOOD ASSET ENDOWMENTS ANALYSIS

4.1. Introduction

A livelihood involves various assets, strategies, activities and other factors necessary for living (Chambers and Conway, 1992). The ability of households to pursue different livelihood strategies depends on their access to and control over basic materials and social, tangible and intangible assets (Scoones, 1998). Households require a range of assets to achieve desirable livelihood outcomes they anticipate. They often have access to and control over livelihood assets, such as natural asset, human capital, physical asset, social capital, commons and public goods at their disposal to make a living (Dercon, 2001). A single asset category can generate desirable livelihood outcomes but not sufficient to enable households to achieve their multiple livelihood goals. Nonetheless, mere asset endowments may not guarantee that households achieve food security (DFID, 1999). Hence, analysis of asset endowment of households requires examining sequencing, substitutability, and clustering of assets; and accessibility of households to social and public assets and tradeoffs which may result in different livelihoods strategies pursued over time (Scoones, 1998). The sustainable livelihood approach tries to gain accurate and realistic understanding of strengths (asset endowments) of people and the way they convert these assets into positive livelihood outcomes. The approach identifies five core assets upon which household livelihoods are built (DFID, 1999). This asset endowment of households determines their resilience to undesirable livelihood outcomes (poverty/food insecurity/shocks). The more assets households have, the more resilient they are. It is indeed impossible to measure resilience of households without measuring their livelihood asset endowment, safety nets, and the functioning of markets that determine opportunity sets and the range of activities the households can pursue to manage risk (Alinovi, Mane and Romano, 2009).

Monetary measures of food security such as income and consumption expenditure have long been the favored metrics due to their spatial and temporal comparability and simplicity to interpret and operate (Moser and Felton, 2007). However, monetary approaches have proved to be incapable of capturing the multiple dimensions and variables used to measure livelihood assets households hold on due to recall bias, seasonality and data collection burden (Moser and Felton, 2007). Moser and Felton further underlined that monetary approaches are absent, seasonally volatile, or unreliable in economies where a large fraction of economic activities is carried out outside of the market realm. Monetary approaches such as consumption expenditure

and income are dominated by food seen as an exclusive private good consumed exclusively and equitably within a household (Filmer and Scott, 2012). It is important to search for and deal with other proxy measures of livelihood outcomes. This chapter intends to estimate livelihood asset endowment of households using composite asset index. Composite asset indices are computed and derived from goods and services available at the household level (Filmer and Scott, 2012). They provide a complete picture of long-term household wellbeing and living standard than an income snapshot (Moser and Felton, 2007). They are proxy measures of long-term household economic status and food security. They measure the multidimensional concepts which cannot be captured by a single indicator (OECD, 2008). The term indicator here refers to factors that can best describe each of the five livelihood assets (Pasteur, 2001) in the study area. This composite asset index helped us construct a composite score of household assets without which measuring a single asset would not tell us the exact capacity of the household. It is a composite measure putting different variables together using a rule or a set of rules. Composite index is a quantitative score, a numerical value, used to measure variables of different constructs. It is a composite indicator of wellbeing (OECD, 2008). The composite asset index here is the sum of the five core assets building livelihoods of a rural household.

The researcher (1) made an exhaustive literature review and chose important indicators of interest from the global literature; (2) set a weighting scheme for each variable; and (3) summed each indicator in each asset type and combined the five asset dimensions altogether to derive the aggregate asset stock of each household. The selection of variables heavily relied on the normative decision the researcher made to reconcile the tradeoff between the possible redundancies caused by overlapping information and the risk of losing information. In fact, MCA was used to overcome such risks. This multivariate statistical tool revealed the underlying correlation between variables and retained the indicators (or variables) that best summarize the available information (see next section). The researcher finally used asset pentagon to easily portray variations in patterns-of access to assets between the studied households. The central point of the pentagon represented zero access to assets while the outer perimeter represented maximum access to assets (Chen et al., 2013). The pentagon was constructed through calculating the asset indices that can capture and aggregate the different assets households own into a single variable. In fact, asset index scores close to zero demonstrate low asset endowment while asset index scores close to one imply high asset endowment of households.

4.2. Weighting Methods

The study figured out the best (weighting) method of combining each component score to create a single composite asset index. Weights essentially reflect the contribution of each indicator to the composite index (OECD, 2008). There are broadly two popular weighting schemes circulating in the literature. The first and most popular weighting scheme refers to equal weighting. The basic reason behind equal weighting is that all the dimensions and variables which make up the composite index are equally important to the welfare of the poor. Equal weighting, however, does not necessarily mean “no weights” but implicitly implies that the weights attached to each indicator and variable in the composite are equal. In other words, equal weighting implies that all variables are worth equally in the composite indicator (OECD, 2008). UNDP usually applies equal weighting to compute the annual Human Development Index (UNDP, 1997). However, despite global or national comparability advantage, equal weighting do have a number of well documented shortcomings in the literature. The researcher thought that the dimensions and variables that made up the asset index are not equally important to the livelihood of the rural households and should be weighted unequally.

Weighted index is the second composite indicator construction method in the literature. It usually refers to a quantitative score made up of unequally weighted multiple indicators and variables. There are several unequal weighting determination methods and techniques in the literature the researcher had to choose on how to derive a weighted asset index. Yet, it is very important to bear in mind that regardless of which method is used; weights are essentially value-laden (OECD, 2008). Hence, the choice of weighting method could not be value free.

First, researchers opt to determine and fix the weights attached to each dimension and variable in composite indicator construction by consulting development practitioners, experts and policy analysts (Njong and Ningaye, 2008). This is a normative decision made by experts on the welfare value of each component in an index. Second, weights may also be determined based on the data quality of the variables of interest (OECD, 2008). This method leads us to attach high weights to statistically reliable and more valid data and less weight to statistically unreliable and less valid data. In other words, composite index does reflect the true picture of household welfare if and only if we attach more weight to high quality data. This in turn leads us to focus on asset dimensions and variables which are easier to measure and readily available. It punishes data which are statistically more problematic to identify and measure (OECD, 2008). It does not

help us explore and measure more abstract dimensions and variables of livelihood (social) asset profiles of the poor.

The third, public preference, weighting determination method is closely related to and continues from the first (expert consultative) method (Njong and Ningaye, 2008). Research stakeholders involved in the research process (such as researchers, sponsoring organizations, government representatives and the public) determine and set the weights attached to each variable in the index (OECD, 2008). Here, whose preference matters invalidates the application of public preference weighting determination method in this study. The fourth method goes to price of items based determination of weights. This fourth method, commonly known as consumer price indexing, which has long been applied to determine the weights attached to each variable in the index; does not work here in this study. This is because the variables (goods and services) in the dataset are not priced nor have monetary equivalence. Multivariate statistical method is the last and widely used weighting determination. It is data-driven (or frequency-based) weighting determination method (Perez-Mayo, 2005). This study actually derived the weights attached to each variable and asset dimension using multivariate (MCA) tool (see next section).

4.2.1. Multiple Correspondence Analysis

The researcher planned to use Principal Component Analysis (PCA) to compute asset composite of households. PCA is a multivariate data analysis technique used to reduce the dimensions and number of variables in interrelated datasets into a new ordered set of fewer less correlated variables which retain most of the variations in all of the original variables (Jolliffe, 2002). However, PCA is essentially designed to analyze a set of quantitative variables measured in the same units (Booyesen et al., 2008). It is used to analyze normally-distributed continuous and quantitative variables (Asselin and Anh, 2008). It also requires linear constraints that assume the distance between the categories are the same and the categories are ordered (Booyesen et al., 2008). However, the asset dataset of this study constitutes categorical variables (measured at nominal and ordinal level). These categorical variables do not have an origin (a continuous unit of measurement) and hence means, variances and covariance have no real meaning. The application of quantitative PCA to such categorical dataset is thus inappropriate. The study indeed employed MCA to avoid the limitations of the PCA. MCA allows us to treat the categorical variables in the asset dataset. It allows researchers to analyze the pattern of relationships between and within a set of categorical variables. It is used to analyze a set of

categorical variables. Each categorical variable comprises several levels, and each of these levels is coded as a binary variable. It can also be used to analyze quantitative variables by recoding them as “bins” (Abdi and Valentin, 2007). MCA makes little (or no) assumption about normality in distribution of variables (Booyesen *et al.*, 2008). MCA was indeed applied to reduce the dimensionality of the data available in the matrix and generate a composite asset index.

The study followed the footsteps of Asselin and Anh (2008) composite poverty indicator calculation method to calculate the livelihood asset index. The calculation of composite indicator has four stages. First, the researchers constructed indicator matrix (of ones and zeros) that shows the asset ownership of each household. They made an indicator matrix (of asset ownership) where the households were displayed as rows and each asset ownership category was displayed in the column. The MCA coded the categorical data by creating several binary columns for each variable with the constraint that one and only one of the columns got the value 1. The coding schema created artificial dimensions because one categorical variable was coded in several columns. Each categorical asset ownership variable is reduced to a set of binary indicators where every household indicated a “1” in exactly one of each set of asset columns (or categories) and a “0” in all other columns. Second, the researchers calculated asset ownership of each household in each asset category. The row profiles of a matrix are the rows of that matrix, each divided by its row sum. Third, they applied MCA to the original indicator matrix and attached a set of category weights from the first dimension (or factorial axis) of the analysis results. Lastly, they applied these category-weights to the profile matrix to calculate the weighted asset composite index score of each household by summing up all of that household unit`s weighted responses.

The normalized statistical output in the MCA analysis constitutes categories, mass, overall quality, percentage of inertia, and the coordinates of each category of the artificial dimensions. The coordinates show the correlation between the principal dimensions and the original variables; and the weights each indicator contributes to the construct under scrutiny. The largest coordinate loaded on each category of an indicator was used as a weight for that indicator. The signs of the coordinates precisely donate the direction of the relationship of the indicator with food security and other indicators used to construct the respective index. The magnitude of the coordinates (weights) indicates the contribution of each indicator to the value of each index.

MCA generates a relevant composite indicator if and only if it meets the fundamental consistency requirement axiom. The construction of Composite Asset index (CAI) from K categorical indicators must meet the monotonicity axiomatic requirement (Asselin and Anh, 2008). The axiom explicitly implies that if a household i improve its situation for a given indicator, then its composite asset index value CAI_i increases and then it improves its desirable livelihood outcomes (food security). The monotonicity axiomatic requirement translates into first axis ordering consistency and global first axis ordering consistency principles. In fact, if the first axiom provided a relevant composite indicator, the second axiomatic requirement to compute the aggregate indices can largely rely on the standard welfare measurement. The first axiomatic requirement implies that the first axis must have growing factorial scores indicating a movement from asset poverty to non-poverty situation. For each of the categorical variables, the MCA calculates a discriminatory measure on each of the factorial axes. It is the variance of the factorial scores of all the modalities (categories) of the variable on the axis and measures the intensity with which the variable contributes to the axis. The weights given by MCA correspond to the standardized scores on the first factorial axis. When all the variable modalities have been transformed into a dichotomous variable coded as 0/1, the calculation of the CAI score of each household can mathematically be rewritten as:

$$CAI_i = R_{i1}W_1 + R_{i2}W_2 + R_{i3}W_3 + \dots + R_{ij}W_j + \dots + R_{ik}W_k \dots \dots \dots 4.1$$

Where CAI_i is the i^{th} household's composite asset indicator score, R_{ij} is the response of household i to category j and W_j is the CAI weight for the first dimension applied to category j. The weights, W_j , attached to each asset are the eigenvectors of the covariance matrices. The eigenvector with the highest eigenvalue (coordinate) is used to calculate the asset index. The first eigenvector is the vector that minimizes the squared distances from the observations to a line going through the various dimensions.

The CAI constructed using MCA has a tendency of being negative in its lowest part. It is thus difficult to interpret the negative CAI results. It can, however, be made positive by a translation using the absolute value of the average C_{min} of the minimal categorical weight W_{min}^k of each indicator. The absolute value of C_{min} can then be added to the CAI of each household to generate the new positive CAI scores. The coefficients attached to each variable in the asset index construction have a fairly intuitive interpretation (Moser and Felton, 2007). The coefficient attached on any one variable refers to the amount of information that variable

contributes to a particular factor compared to the other variables. Moser and Felton underlined that positive coefficient on any asset ownership indicates that a household does own another asset. A zero coefficient attached to any asset ownership indicates little or no information about what other assets the household owns. A negative coefficient attached to any asset ownership indicates that the household does possibly have few other assets. The magnitude of the coefficients (weights) attached to any asset ownership indicates equivalent information about other assets the household accesses to and controls over it.

4.3. Livelihood Asset endowments Analysis

This section describes and measures the key livelihood asset endowments of rural households in the study area.

4.3.1. Natural Asset Endowment Analysis

Natural asset denotes the natural resources and environmental services from which resources and services important to household livelihoods are derived (DFID, 1999; and Krantz, 2001). Natural asset is necessary to all human beings. Yet, it plays a differential role in rural households who derive all (or part) of their livelihood economy from agriculture. The importance of natural asset goes beyond livelihood asset provision. No one of us survives without the help of key environmental (ecosystem) services nature provides (DFID, 1999). Natural assets affect livelihood options and outcomes of households (Degefa, 2005). The researchers here estimated natural resources endowment (land resources, water resources and forest and vegetation resources) of households using descriptive and MCA statistics.

Land Resources: Land is one of the most important factors of production essential to agricultural production. It is a basic natural asset of rural livelihoods without which farming is impossible. It is also a source of wealth and political power (Yusuf et al., 2009). Households whose livelihood depends on agriculture need to have a proportionate farmland that can support the lives of all members of their household. Land resource here refers to the physical land (landholding size and land fertility), and the policy towards land which governs land tenure security, land holding size, land transactions and other resources embedded in it.

Land Tenure System and Land Holding Size: Land tenure system and land policy regulates livelihood and food security of rural people. It refers to the mode through which land is held or

owned, used, and transferred plus the set of relationships among people concerning land or other resources embedded in it (Yusuf et al, 2009). Ethiopia has historically experienced multiple land tenure systems. Multiple land tenure systems have also simultaneously coexisted in the long history of the country. However, the land tenure dynamics have contributed little to the structural transformation of the national economy (Degefa, 2005). The structural economic transformation pace of the country has been very disappointing. World Bank (2015) confirms that structural change has been remarkably absent from Ethiopia's story of progress. The land policy of the country has been contentious; attracting the attention of almost all development experts in the society. It has often labeled as the midwife of all sorts of development failure in the country. Perhaps there is rich literature on the typology of land tenure systems Ethiopia has experienced over centuries (see Dessalegn, 1984; Berhanu N., Berhanu A., and Seyoum G., 2003; Hussein, 2001; Crewett and Korf, 2008; Getnet, 2009; Getnet and Malek, 2010) and hence no need to research it here again. The researcher rather tries to examine the effect of the existing public land tenure system on agricultural production and food security of households.

The Federal Democratic Republic of Ethiopian constitution article 40(3) placed the ownership of rural land in the state, local communities, and the private sector. The constitution further affirms that most land is a common property of the people of Ethiopia and shall not be subject to sale and other means of exchange. The constitution and the Rural Land Administration and Use Proclamation (Proclamation No.456/2005) also stipulates that peasant farmers, pastoralists and semi-pastoralists who are or who wish to be engaged in agriculture have only usufruct rights and cannot sell, exchange or mortgage the land. This policy has been in place since the 1974 land reform. This constitutional provision and legal framework not only protects land selling, exchange or mortgage that discourages labor and capital movement from rural areas to urban centers but also it is fixed that cannot be changed easily. Dorosh et al. (2011) also asserted that the land policy of Ethiopia has been designed to slow rural-urban migration through regulatory measures prohibiting sale of land, loss of land rights for those who leave rural areas, and registration requirements for new migrants. It is therefore argued that the land policy of the country has been designed to detain the rural youth in the rural areas and it hampers structural economic transformation in the country. The basic reasons behind the customary land policy of the government include the fear of mass smallholder displacement, inflation and monetary transfer without real value addition and lack of capital. This is, however, not logically convincing given the mass displacement of smallholder farmers in the name of

large scale private sector investment. Smallholder farmers might rather have made a significant livelihood change if they were allowed to sell their lands.

Households access to and control over land influences their livelihood and food security status. The federal rural land administration and use proclamation of Ethiopia (Proclamation No.456/2005) stipulates that any Ethiopian citizen who wants to engage in and make a living from agriculture can acquire land either by distribution, redistribution, settlement programs, donation or inheritance. The land administration and implementation of the proclamation rests on the shoulder of the regional states (Getnet, 2012). Likewise, the rural land administration and use proclamation of Tigray national regional state (Proclamation No. 239/2006) stipulates that any Ethiopian citizen, who wants to engage in and make a living from agriculture, can acquire land by distribution, redistribution, donation or inheritance. Any Ethiopian citizen who lives in one of the rural *Kebeles* of the region has the legal right to acquire farmland in that *Kebele* and use it without time limit. The rural land proclamation of the region legally allows any Ethiopian citizen (above 18 years old), living in Tigray, who wishes to engage in and make a living from agriculture can acquire land free of charge. In fact, almost all households had access to land either through land distribution (69.04 percent), redistribution (13.2 percent), inheritance (15.99 percent) and other means of land transaction including leasing in and crop sharing. Only a small number of households had no access to land. They are landless. The rural land administration and use proclamation of the region permits annual rural land redistribution. The region held the largest land distribution in 1990s when EPRDF seizes power. Rural land redistribution and settlement has since then been held annually in the region. Households who have access to and control over land had expected to receive higher weight (food secure) and those who have no access to or control over land had expected to receive less weight in the MCA computation. The MCA model has, however, rejected the agricultural land ownership dichotomous variable because of the small percentage of landless households. That is, agricultural land ownership does not significantly vary across the studied households in the area. Access to and ownership of land does not create a livelihood and food security disparity in the area.

Land households hold per capita also determines their agricultural output and food security status. Recognizing the low productivity; agricultural technology generation and application as well as the danger of further fragmentation of parcels of land, the federal rural land administration and use proclamation (Proclamation No.456/2005) fixes the minimum size of

land below which households should not acquire rural land (through any means) which cannot support their food needs. Regional governments decide on the minimum size of rural land granted to anyone who wants to engage in and make a livelihood from agriculture. In fact, the minimum rural land households acquire varies from region to region. The Amhara national regional state rural land regulation (Regulation No. 51/2007) states that the minimum rural land granted should not be less than 0.2 hectare if the land is rain-fed and 0.06 hectare if it is irrigated land. The Tigray national regional state rural land administration and use proclamation also stipulates that the minimum rural land granted to a household should not be less than 0.25 hectare if the land is rain-fed. The maximum rain-fed land size households can acquire varies from locality to locality but should not exceed 1.75 hectare. The proclamation does not specify the minimum irrigated land households can acquire in the region. The average landholding size (0.79 hectare) of the studied households was almost equivalent with the national average landholding size (0.81 hectares) and less than the average landholding size of Tigray national regional state (1.05 hectare). The minimum and maximum landholding size was 0.06 hectare and 2 hectares, respectively. The researcher categorized the landholding size of the households into households who hold below average farmland size and households who hold above average farmland size for the ease of statistical analysis. This dichotomous variable, however, does not satisfy the monotonicity requirement of MCA and hence was it excluded from the analysis. The MCA result revealed that households who hold above average farmland size scored negative weight; demonstrating farm size does not create food security disparity between households.

Land (soil) fertility measures perception of farmers on the fertility of their farmland relative to others. It conditions crop productivity which in turn affects food security of households. The survey result of the study revealed that 52.3 percent and 37.8 percent of the studied households believe that the fertility of their farmland was ‘medium’ or ‘good’ relative to others respectively. Conversely, the focus group discussants unanimously believe that the soil fertility is poor leading to low crop productivity. The discussants added that shortage of land, soil erosion and fluctuation of rainfall constrains efficient use of land by farmers.

Water Resources: Water is one of the most critical natural resources without which human life cannot survive. Access to adequate and safe water supply is not only a fundamental need and can be seen as a human right; but it also has considerable health and economic benefits to households and individuals. Water is also a critical input for almost all types of

production. There is also a strong nexus between food security and access to adequate and safe water supply. Adequate and safe water supply reduces vulnerability of households to shocks; increasing food availability and enhances utilization of it by households (Degefa and Tesfaye, 2008). Ahferom *Wereda* generally has inadequate water resources endowment due to natural shortage of ground water, recurrent drought and unpredictable rainfall, fast human population growth, environmental degradation (deforestation), protracted civil war, and limited investment in water resources development (USAID, 2000). Drought has also become a common experience in the area. This recurrent drought grossly lowers farm production and productivity which consequently results in food deficits and dependency on food aid.

Water resources are constituted by natural surface and ground water endowment, water resource development and management for both domestic and irrigation purposes and any other means of accessing water for such purposes. The researchers disaggregated the water resources into domestic water and production (irrigated) water categories in the computation of the natural asset index. The study further classifies domestic water supply into improved (potable) water source and unimproved water sources where the former source of water refers to potable water sources protected from external contamination while the latter refers to unprotected natural water sources. The improved water sources include piped private lines, public tap/stand pipe, and tube well/borehole, protected dug-wells, rain water harvesting and protected springs. Unimproved water sources include unprotected dug-wells, unprotected springs and surface water (river, dam, lake, pond, stream, and irrigation canal). In the MCA natural asset index computation, households who have access to improved water points were expected to receive positive weight while others who have no access to it receive negative weight.

Irrigation development and use is one of the best possible livelihood strategies to reduce food insecurity in the country (Seleshi et al., 2007). It has long been proved that irrigation enhances agricultural production and productivity which in turn reduces the structural food insecurity of the country. In fact, irrigation is one of the major pillars of the ADLI development strategy of the government of Ethiopia to increase food production and food self-sufficiency for the country. Tigray is one of the most recurrent drought induced food security affected regions in the country. A multitude of factors contribute to the structural food shortage in the region. The limited and erratic nature of rainfall is one of such factors adversely affecting crop productivity in the region. Conversely, the region has a tremendous irrigable land potential of 325,000

hectares (Eyasu, 2005). In fact, irrigation development and expansion is one of the top policy aims of the regional government. Farm households must have access to at least one alternative irrigation water source. Access to irrigation is thus important variable in the natural asset index construction. This variable is categorized into irrigation users and nonusers where irrigation users are perceived to receive higher weight (food secure) while the nonusers received low weight (food insecure) in the analysis. The result of the descriptive statistics, however, revealed that majority (69.29 percent) of the households had no access to irrigation in the *Wereda*. Only 30.71 percent of the households have access to and practice irrigation in the area.

The water resources endowment and development varies across the agro-ecology of the study area. There are relatively abundant surface and ground water resources in the highland and midland areas of the *Wereda*. Perennial rivers, seasonal streams and springs, water ponds and wells used for sanitation, livestock trough and small-scale irrigation purpose are common in these areas. Labor-intensive water resources development is indeed feasible in the highland and midland zones of the study area. Conversely, there exists surface and ground water scarcity in the lowland agro-ecological zone of the area. Neither labor-intensive potable water supply nor irrigated water resources development is feasible in the lowland areas. Only capital-intensive water resources development is feasible in the lowland areas. This scarcity of water resources significantly retards the provision of potable water to the low land community. Furthermore, the northern part of Ahferom *Wereda* is bordered by Eritrea. The no-peace-no-war relationship between Ethiopia and Eritrea and the political instability prevailing in the lowland *Kebeles* particularly the fear of land-mine explosions and haphazard attacks to snatch the heavy drilling machines has been typical challenges that hamper water supply investment in these *Kebeles*.

Forest (Vegetation) Resource: Forests provide immense ecosystem goods and services for livelihoods, hydrological regulation, socioeconomic and political benefits, cultural heritages, and spiritual and religious values to human beings. The study indeed assessed the forest (vegetation) resources in relation to livelihood benefits they provide to the households. The study area was historically covered by dense forests. There is still surviving evidence of perennial trees and big bushes in churchyards and river courses. However, the natural forest coverage was largely destroyed through long duration encroachment of subsistence cultivation. The vegetation cover dwindled to only three percent in the 20th century. Consequently, the area has become drought prone. It receives, on average, 733 mm rainfall but with erratic variations.

In order to regenerate the natural forest cover, the government has endorsed a well-articulated environmental protection policy and has mobilized the public in a soil and water conservation campaign. The environmental protection policy includes soil and water conservation, area closure, and afforestation and plantation. The outcome of the environmental protection policy of the government is very promising and visible (Tagel and Veen, 2010). Forest (vegetation) resources are now very important means of livelihood in the area. The rural poor reap income through selling firewood and charcoal, cactus, eucalyptus and gesho (equivalent to hop plant). This study thus took access to, and selling of, firewood and charcoal, cactus plantation, eucalyptus plantation, and hop plantation to measure the forest resources dimension of the natural asset stock of the farm households in the area.

The MCA model has, however, excluded such important natural asset variables as firewood and charcoal selling, safe water access, water resources adequacy, irrigation use; cactus fruit selling, eucalyptus selling, grazing land and land holding size from the analysis because they did not meet the monotonicity criteria of MCA. The study indeed has used mode of land acquisition, land (soil) fertility, farming methods, farm land convenience, and type of irrigation, and hop crop selling variables to compute the natural asset capital using equation 4.1. The average natural asset composite index of the households was indeed equal to 0.1214693. The MCA analysis demonstrates that mode of land acquisition; land fertility, farming methods, and farmland convenience to plough have negatively impacted food security of households. Conversely, the type of irrigation households use and hop crop selling enhances food security of households. Land fertility, mode of land acquisition, and land convenience make significant contribution to the natural asset differential households accumulate. The MCA model portrays that the fertility of the farmland households possess makes critical food security disparity in the area. The model further illustrates that land acquisition through resettlement programs, and rent in and crop sharing have adverse influence on food security of households.

Table 3: Natural asset stock multiple correspondence analysis coefficients

S/No.	Natural asset indicators	Natural asset categories	Index coefficients
1	Access to firewood and charcoal	Negative	Does not meet MCA
2	Access to potable water	Negative	Does not meet MCA
3	Water resources adequacy	Negative	Does not meet MCA
4	Source of irrigated water	Negative	Does not meet MCA
5	Access to and use of cactus fruit	Negative	Does not meet MCA
6	Access to and use of eucalyptus	Negative	Does not meet MCA
7	Access to grazing land	Negative	Does not meet MCA
8	Land holding size	Negative	Does not meet MCA
9	Mode of land acquisition	Land distribution	0.166
		Inheritance (and transfer)	0.752
		Redistribution (resettlement)	-5.624
		Rented in and share cropping	-0.437
10	Land quality	Good	0.989
		Fair	-0.733
		Poor	-7.892
11	Land farming methods	Oxen	0.001
		Hand tools (human labor)	-0.126
12	Farm land convenience	Convenient to farm	-7.410
		Inconvenient to farm	0.253
13	Type of irrigation	River diversion	-0.315
		Dam	0.320
14	Hop plantation	No	-0.073
		Yes	0.120

Source: Author`s computation, 2018

4.2.2. Human Asset Endowment Analysis

Human asset is constituted by the skills, knowledge, ability to work (or labor) and good health that altogether enable people to pursue different livelihood strategies to reduce food insecurity (Scoones, 1998; DFID, 1999; and Krantz, 2001). It is investment in education, health and nutrition which usually affects the ability of the people to use their labor and change their returns from their labor (Moser and Felton, 2007). Human capital for a typical rural household represents the amount and quality of labor time available that varies according to size, skill, and health condition of household members (DFID, 1999). Nonetheless, it is literacy, health condition (Degefa, 2005), and time and energy of household members that matter most to reduce household food insecurity. This study uses farm experience of the household head, household headship, marital status, education, health condition, family size, and household labor force indicators to measure human capital and construct human capital asset index.

There are two contrasting views about the impact of farm experience on food security status of household in the food security literature. The first view underscores that farm experience has a positive impact on household food security; that is older household heads have richer experiences of the social and physical environments as well as better experience of farming and cropping calendar (Hofferth, 2004). They have better access to land and stable economy in farming than their younger household head counterparts who have to either wait for land redistribution or share land with their families (Tsegay, 2009). The second sort of literature views farm experience to have a negative impact on household food security where the young household heads have better opportunity to cultivate large-size farmlands than their older counterparts (Babatunde et al., 2007). Younger household heads also have better opportunities to use new science and technologies. This study measured the farm experience of households by age of the head and categorized it into categorical variable for the ease of computation. In fact, the average age of the studied farm household heads was 49 years old.

Education and household livelihoods have a direct linkage in modern market economy where literate individuals tend to earn more income than their illiterate counterparts. In such modern economy, household income is used as a proxy measure of education. Paradoxically, income does not tell us the true value of education in subsistence farming economy. Yet, the value of education is embedded in the livelihood of households. Literate households differ from illiterate households in multiple respects. They can (1) easily understand the importance of modern agricultural inputs and technologies; (2) better manage agricultural and nonagricultural production resources; (3) have better opportunities to engage in and reap more income from nonagricultural ventures; and (4) are more involved in and play disproportionate role in sociopolitical affairs of the community than their illiterate counterparts (Degefa, 2005). Hence, income does not measure the true value of education nor does it measure the inherent human capital specific to the individual members of the household and the indigenous knowledge and extensive lifetime experiences they have acquired. Rural households most often acquire knowledge/education through adult literacy programs, formal education, training programs and other means of knowledge acquisition. This study takes literacy (household head literacy), formal educational level of the head, and participation of any household member on training programs; and access to agricultural extension services variables to measure the indicator, education, in the human capital index.

Literacy determines the decision power of a farmer to accept or reject modern agricultural technologies that can boost production and productivity. It also influences how a farmer behaves and manages resources. The descriptive statistical analysis reveals that great majority (73 percent) of the household heads are literate. This high literacy level might be due to the long-term existence of spiritual education (Ethiopian Orthodox Church), adult literacy programs and school expansion programs of the government. The researchers observed that many of the older household heads are priests and the young ones have some formal education. The study further found that 48 percent and 7.25 percent of the household heads studied in primary and secondary schools, respectively. Training is also an important mode of farmer education. Governments and nongovernment organizations deliver short-term training programs on rural entrepreneurship, early warning, natural resources management, postharvest handling and management; and marketing to farm households in the area. Such training programs not only demonstrate and share new agricultural inputs and technologies to farmers but it also help them receive up-to-date agricultural and market information. The study revealed that 66.75 percent of the household heads took training on all or either of these important programs. Schultz (1964) has long recognized the importance of access to and application of modern agricultural inputs and technologies to improve agricultural production and productivity. The idea of Schultz tells us that unless farmers have access to and use what modern science tells about agriculture and application of modern agricultural inputs and technologies, they could not improve their farm productivity. In fact, the study investigated whether or not farm households have access to modern agricultural inputs and technologies as well as agricultural extension services and found out that almost all of the studied households have access to such agricultural inputs and services in the study area.

Labor has long been recognized as a principal factor of production especially in agrarian society where smallholder agriculture is the largest share of the economy. The sector favors active labor force and labor-intensive agricultural technologies over capital-intensive technologies which could substitute for labor. The study considers family size and dependency ratio to compute the human capital index. Family size determines the living standard and food security condition of households. Two households with the same income but different family size are usually expected to have different ways of living (USAID, 2000). The study found that the average family size of the households was 6.1. This average family size in the area is higher than the national and regional average family sizes which are 4.7 and 4.9, respectively (CSA, 2007).

The descriptive statistics confirmed that households who have large family size are more food secure than households who have small family size. This (food secure) large family size contradicts with the longstanding fact that households who have large family size probably fall into poverty trap and food insecurity. First, family size in the area has a direct relationship with landholding size. Households acquired farmland proportional to their family size in the 1990s land distribution program. Second, the Productive Safety-Net Program (PSNP) encourages larger family size. The focus group discussants confirmed that the PSNPs provision mainly benefit households who have large family size. Third, when farm production does not support the food need of households, youth opt to migrate to other parts of the country and outside. The emigrants, in return, are a main source of household income. Fourth, female headed households and the elders who usually have small family size are easily trapped in a vicious circle of food insecurity. Households with large family size were more food secure than those households who have small family size in the area. The MCA analysis also confirms that small sized households are food insecure compared to large families

Gender inequality is a socio-culturally constructed disparity between men and women. It refers to the different social roles that men and women play and the power relations therein between the two counterparts. The gender inequality may be structured and perpetuated by the economy, the political system and other social institutions. Gender relations influence how communities, households and institutions are organized; how decisions are made; and how resources are accessed and used. The Federal Democratic Republic of Ethiopian constitution stipulates that women have equal right to access and control over productive resources. They are also equally responsible to head their household. In fact, the Central Statistical Agency of the federal government defined the head of the household as any member of the household who is recognized as a head by the members (CSA, 2007). However, because of the deep-rooted socio-cultural systems, Ethiopia is a patriarchal country where men dominate households. Household headship has a direct correlation with access to and control over assets. The studied households were largely (71 percent) male headed. Only 29 percent households were female headed. There is ample rich empirical evidence that confirm female headed households face food shortages more than their male headed counterparts. The MCA analysis also confirmed that female headed households were food insecure compared to their counterparts.

Labor carries out basic agricultural operations (land preparation, weeding and harvesting) and livestock rearing. It is an important reserve of human capital of households which can be exchanged for oxen time to compensate draught power shortage and can directly be used to generate cash income (Degefa, 2005). Households who have large labor force are better to increase the productivity of their farm (Hofferth, 2004). The households in the study area depend on family labor, reciprocal labor exchange, hired labor, and social capital labor networks in time-use ranking order of their importance to carry out farm operations. In fact, the households opt to hire labor and acquire social capital labor if and only if they are wealthy and better-off relative to other farm households. The study found that 60.75 percent of the households enjoy adequate labor. Only 39 percent of households had labor scarcity. The focus group participants claimed that cultural taboos discourage people to work for other households in their locality. The people do not exploit the local casual labor employment opportunity; instead; they prefer to migrate somewhere else even for equal pay. However, the household labor scarcity does not necessarily imply the availability of appropriate job opportunities. It is common to meet college and university graduates in almost every household in the area. Indeed, shortage of appropriate job opportunities is the greatest headache of the local administration. The finding of MCA analysis reveals that households who have large labor force tend to be food insecure in the area.

Dependency ratio is another important factor exerting adverse impact on the productive age group of the farm households. It threatens food security of farm households. The dependency ratio is the ratio of the number of dependents (age groups between 0-14 and 65 and above) divided by the productive age group (15-64). It is normally expressed as a percentage (Todaro and Smith, 2012). It creates intra household economic dependency and causes economic variation across households. The ratio increases consumption expenditure of households and social safety-net budget of the government. It lowers per capita income of households. The larger dependency ratio the households are the less food secure they would be. Over 90 percent of households had dependent members in their family. Only 9.5 percent of the households had no dependent members in their family. The mean age dependency ratio of the sampled households was equivalent to 0.96. This shows that, on average, each household has almost one dependent member whose livelihood heavily relies on the productive household members. The MCA analysis portrays that dependency ratio has a loose link with food security demonstrating that the perceived unproductive members of a household are not really unproductive.

There is a direct relationship between health and wellbeing. A healthy society does make a significant contribution to overall national development through direct participation in the economic sector and indirectly via little health sector budget utilization (Degefa, 2005). In Ethiopia, majority of human diseases are caused by lack of personal hygiene and environmental sanitation. The government has progressively formulated well-articulated national health policy (1993), long-term strategic Health Sector Development Program (1998), Health Extension Program, and National Reproductive Health Strategy (2006) to meet the health needs of all Ethiopians. The Health Extension Program (HEP) is an innovative community-based approach formulated to avail preventive, promotive and minimum curative, and rehabilitative health service packages near the household (MOH, 2006). The HEP has four components: (1) family health, (2) disease prevention and control, (3) personal hygiene and environmental health, and (4) health education and first aid. It also intends to accelerate health center expansion which focuses on curative services. The government deployed two health extension workers per *Kebele* to properly implement the health extension program. The second alternative health policy of the government focuses on expansion of health facilities and provision of quality health services to cure ill members of the community. Indeed, over 89 percent households in the area have physical access to health facility. The government has constructed health posts in almost every rural *Kebele* in the *Wereda*. There are 7 health centers, 4 clinics and 22 health posts in the *Wereda*. However, the health posts did not have necessary medical health personnel and material. Over 94 percent of the breadwinners were healthy. The study revealed that 87.75 percent of the farm households have constructed latrines. Yet, they use the facility irregularly. Over 13 percent of households defecate openly near their homestead.

The study has used sixteen monotonically valid variables to compute human capital index using equation 4.1. The MCA analysis shows that all of the variables have a common pattern demonstrating the negative impact of gender inequality, family breakings, illiteracy, poor health, small family size and lack of training on food security of households. The model revealed that female headed households are food insecure compared to their male counterparts. It also demonstrates that younger farmers are food secure relative to their older counterparts. The model confirms that small sized households tend to be food insecure compared to large size families. It similarly approves that illiterate and unhealthy households tend to be food insecure compared to their literate and health households. The average human asset composite index of the households was equal to 0.175.

Table 4: Human asset stock multiple correspondence analysis coefficients

	Human asset indicators	Human asset categories	Index coefficients
1	Dependency ratio	Negative	Does not meet MCA
2	Agricultural extension contacts	Negative	Does not meet MCA
3	Labor adequacy	Negative	Does not meet MCA
4	Household headship	Male headed	1.119
		Female headed	-2.743
5	Marital status	Single	1.476
		Married	1.032
		Divorced	-3.104
		Widowed	-3.701
		Separated	-2.082
6	Age of household head	20-35 years old	0.131
		35-50 years old	0.084
		51-65 years old	-0.022
		65 -80 years old	-0.632
7	Family size	1-3 household members	-2.387
		4-6 household members	-0.287
		7-9 household members	0.839
		10-12 household members	1.543
8	Literacy	Literate	0.839
		Illiterate	-2.244
9	Formal education	Read and write	-1.494
		Primary school	1.363
		Secondary school	0.042
10	Household health status	Poor	-1.243
		Medium	-0.214
		Good	0.192
11	Household members illness	No	0.033
		Yes	-0.272
12	Household members death	No	0.004
		Yes	-0.502
13	Presence of emigrate members in the household	No	0.225
		Yes	-0.437
14	Business (entrepreneurship) training	No	-0.692
		Yes	0.886
15	Early warning training	No	-1.440
		Yes	0.811
16	Adult literacy training	No	-1.038
		Yes	0.658
17	Natural resource management training	No	-1.700
		Yes	0.114
18	Postharvest handling training	No	-1.918
		Yes	0.595
19	Marketing training	No	-0.364
		Yes	2.172

Source: Author computation, 2018

4.2.3. Physical Asset Endowment Analysis

Physical asset refers to the stock of plant equipment, infrastructure and other productive resources (World Bank, 2000). It comprises the basic infrastructure and producer goods and services necessary to undertake livelihood strategies (DFID, 1999). Physical asset is important to support the poor to meet their desired livelihood outcomes. It directly or indirectly affects the human and financial assets of households (Scoones, 1998). Physical asset can also be either a public good or a private good (DFID, 1999).

Physical asset in this study is divided into nonproductive (or consumer goods) assets, productive (agricultural) assets, and housing as well as basic service categories. Each of these physical asset categories are further divided into multiple indicators and variables for the ease of physical asset index computation. Nonproductive (consumer) goods comprise fixed furniture and utensils the household owns. They include modern stove, modern sofa, beds, radio, tape, television, modern chairs, motorcycles, and cars. Productive (agricultural) assets refer to agricultural implements and tools the farm households possess. They basically constitute plough set, sickle, hoes, spade, chemical sprayer, water pump, grain mill, tractors, stores, and beehives. Housing is also important component of physical capital asset (Moser and Felton, 2007). It constitutes the physical house the household lives in and the toilet it uses. Basic services refers to the public physical infrastructure and social amenities including credit services, public transport, road networks, telecommunication, schools, health facilities, veterinary services, electricity, water and energy distribution systems. The researcher transformed all of these physical asset indicators/variables into categorical variables for the ease of statistical computation using MCA.

The descriptive statistical analysis shows that the studied households had good stock of consumer goods endowment, majority of whom have solar lamp (79.25 percent), metal bed (67 percent), radio (64.5 percent), and mobile phone (91 percent). On the other hand, majority of the farm households had no modern stove (86.75 percent), modern sofa (99.5 percent); wood bed (79.25 percent), leather bed (98.5 percent), tape player (90.5 percent), television (94.5 percent), modern chair (94.75 percent), modern table (97.5 percent), and wheelbarrow (95.5 percent). Likewise, none of the studied farm households had motorcycle, animal cart, car, generator, and fixed telephone. They are absolutely deprived in such high order physical assets. The descriptive statistical analysis further shows that the studied farm households had good stock of basic agricultural implements and tools majority of whom possess plough set (91.25 percent),

sickle (97.5 percent), axe (86.5 percent), hoes (92.5 percent), and spade (88.25 percent). These traditional agricultural implements and tools, of course, enable the farm households operate their small plots. However, they really lacked modern agricultural implements and tools majority of whom had no chemical sprayer (71.25 percent), mechanical water pump (97.5 percent), motorized water pump (94.5 percent), traditional beehive (74 percent), and modern beehive (69.75 percent) at their disposal. Similarly, none of the studied farm households had tractors, and wheel-tillers. This low modern agricultural technology stock reciprocally tells us the prevalence of low order farm operation leading to low agricultural produce and food insecurity. The MCA model rejected the invariably accessible or absent variables because they did not vary across farm households.

Basic public services and infrastructure are the most important components of physical assets. They affect other types of asset possession and accumulation either positively or adversely. Indeed, the result of the descriptive statistical analysis reveals that vast majority of the studied farm households have access to potable water points (90.25 percent), public transport (88.25 percent), access to primary school (98 percent) and health posts (89.5 percent); veterinary services (87.25 percent), credit and saving services (97.75 percent) and agricultural extension services (99.25 percent). The study also revealed that solar energy is the main source of lighting energy in the study area. Conversely, great majority of the households lacked access to road networks (67.5 percent), secondary school (54 percent), public telecommunication (76 percent), electricity (75.5 percent), and alternative cooking energy (67 percent).

The people of Tigray have unique tradition in house construction. Historically they have lived in thatched huts and staircase houses (Hedmo) made from stones, soils and grasslands. The people also never share rooms with livestock. It is important to note here that thatched huts and staircase houses cannot be used to make household wealth differentiation in the area. This study used ownership of thatched house vis-à-vis corrugated sheet roofed house; and the number of rooms in the house the household lives in to differentiate the housing physical capital in the area. Yet, majority (91.75 percent) of the household lives in corrugated sheet roofed houses and hence it does not make any difference. Likewise, the households, on average, have three rooms in their home.

The outcome of the multivariate statistical analysis of physical asset stock of households corresponds with the descriptive statistical analysis. The researcher examined a total of fifty

three categorical variables to compute the physical asset stock of the households in the area. The MCA automatically rejected such important physical variables as modern sofa, motorcycle, animal cart, car, generator, tractors, wheel tillers, stone mill ownership, access to primary and secondary schools, health post, and veterinary centers because they did not vary across households. That is majority of the households had similar access to primary and secondary schools, health post, and veterinary centers and relatively lack such high order productive physical assets as modern sofa, motorcycle, animal cart, car, generator, tractors, and wheel tillers. Conversely, thirty five of the physical asset variables examined did not meet the monotonicity criterion of MCA. In other words, the households have good access to and ownership of these thirty five physical assets but they make little contribution to the asset accumulation and food security differentials of households. Only modern stove ownership, sickle ownership, grain mill access, thatched house ownership, latrine type, and telecom access variables satisfied the MCA monotonicity criterion. The study has used these categorical variables to compute the physical asset index using equation 4.1. The average physical asset index of the farm households was equal to 0.14 while the minimum and maximum physical asset scores were equal to 0.04 and 0.15 respectively.

Table 5: Multiple correspondence analysis invariable physical asset variables

	Physical asset variables	MCA output
1	Modern sofa ownership	Does not vary
2	Motorcycle Ownership	Does not vary
3	Animal cart ownership	Does not vary
4	Car ownership	Does not vary
5	Generator ownership	Does not vary
6	Tractors ownership	Does not vary
7	Wheel tillers ownership	Does not vary
8	Stone grain mill ownership	Does not vary
9	Access to primary school	Does not vary
10	Access to secondary school	Does not vary
11	Access to health post	Does not vary
12	Access to veterinary services	Does not vary

Source: Author`s computation

The MCA analysis to estimate the dimensions (weights) attached to physical asset variables demonstrates that modern stove ownership, motorized mill access; thatched ownership and telecom access enhances food security of households. Conversely, latrine type and sickle ownership exacerbate food insecurity of households. The MCA analysis further revealed that

latrine type, sickle ownership and telecom access have significant contribution in the physical asset stock differentials of households.

Table 6: MCA monotonicity test of physical asset variables

S/No	Physical asset variables	MCA output	Monotonicity test output
1	Number of rooms the household own	Negative	Does not meet
2	Corrugated sheet roofed house	Negative	Does not meet
3	Staircase houses	Negative	Does not meet
4	Wood bed ownership	Negative	Does not meet
5	Metal bed ownership	Negative	Does not meet
6	Saving and credit access	Negative	Does not meet
7	Radio ownership	Negative	Does not meet
8	Tape ownership	Negative	Does not meet
9	Television ownership	Negative	Does not meet
10	Modern chair ownership	Negative	Does not meet
11	Modern table ownership	Negative	Does not meet
12	Wheelbarrow ownership	Negative	Does not meet
13	Solar lamp ownership	Negative	Does not meet
14	Plough set ownership	Negative	Does not meet
15	Axe ownership	Negative	Does not meet
16	Hoe ownership	Negative	Does not meet
17	Spade ownership	Negative	Does not meet
18	Traditional beehive ownership	Negative	Does not meet
19	Modern beehive ownership	Negative	Does not meet
20	Chemical sprayer ownership	Negative	Does not meet
21	Mechanical water pump ownership	Negative	Does not meet
22	Motorized water pump ownership	Negative	Does not meet
23	Irrigation access and practice	Negative	Does not meet
24	Potable water access	Negative	Does not meet
25	Cooking energy	Negative	Does not meet
26	Electricity access	Negative	Does not meet
27	Lighting energy	Negative	Does not meet
28	Road access	Negative	Does not meet
29	Public transport access	Negative	Does not meet
30	Physical condition of the primary school	Negative	Does not meet
33	Physical condition of the secondary school	Negative	Does not meet
32	Physical condition of the health post	Negative	Does not meet
33	Physical condition of the veterinary center	Negative	Does not meet
34	Agricultural extension access	Negative	Does not meet
35	Literacy training institutions availability	Negative	Does not meet

Source: Author computation, 2018

Table 7: Physical asset stock multiple correspondence analysis coefficients

S/No.	Physical asset categories	Physical asset ownership	Index coefficients
1	Modern stove ownership	Does not own	-0.112
		Owns	0.741
2	Sickle ownership	Does not own	-2.445
		Owns	0.063
3	Telecom access	Accessible	2.008
		Inaccessible	-0.118
4	Motorized mill access	Accessible	1.340
		Inaccessible	-0.905
5	Thatched house ownership	Owns	1.652
		Does not own	-1.610
6	Latrine type	Free defecation	-3.230
		Private flush toilet	1.476
		Common flush toilet	1.712
		Shared pit	0.523

Source: Author`s computation, 2018

4.2.4. Social Asset Endowment Analysis

Social capital is one of the most powerful and popular metaphor in the current social science research endeavor (Fredu, 2008). It generally refers to the rules and regulations, norms, obligations, reciprocity and trust embedded in social relations, social structures and institutional arrangements that enable members of a social group to achieve their individual and community objectives (see Scoones, 1998; Moser and Felton, 2007; DFID, 1999; Krantz, 2001). It includes intangible assets households and individuals possess. Social capital prevents wasteful use of public goods, facilitate innovation and help the poor improve their income. Factors of production such as labor, land and physical asset cannot fully explain the economic development disparity at individual/household/community or national level (Grootaert, 2001). In fact, there has been a growing recognition that social capital lies at the center of the economic development disparity between individuals/households/communities and nations. Social capital mediates development opportunities and outcomes (Dudwick et al, 2006). It is relevant at macro, meso and micro level. At macro level, it refers to the public institutions, the rule of law, civil and political liberties (Grootaert, 2001). At meso and micro level, social capital refers to the local institutions and associations, social networks and norms that govern social relationships and interactions among individuals, households and communities.

Social capital has been empirically proved to have it positive impact on the welfare of the poor. It improves the efficiency of rural development programs such as rural water supply and

sanitation, irrigation management, natural resources management, credit provision and health service programs which can benefit the poor (Grootaert, 2001; Yusuf, 2008). It has also been econometrically demonstrated to have desirable impact on Ethiopian household welfare, livelihood diversification and consumption smoothing (Fredu, 2008). In the absence of modern credit markets and formal insurance services, households use their social capital to insure themselves against shocks and pressing stresses. Social capital helps households to use informal insurance mechanisms to manage individual and covariate shocks and stresses. Informal insurance is more effective to cope with and respond to idiosyncratic shocks due to asymmetric information sharing among group members (Fredu, 2008). That means social capital is effective to ensure informal insurers at a specific geographic location providing the network involves people living in a geographically differentiated location, provided information sharing does not become so asymmetric and weak that someone in the group may not know whether other group members face shocks or not. Second, unless group members have heterogeneous livelihoods and living standards, a covariate shock affecting all households would leave them with little or no possibility of insuring one another (Fredu, 2008). This heterogeneity tells us the necessity of linking the macro and micro level social capitals and investigating their relationships. Households can still have and establish a wide stock of social capital useful to their livelihood beyond the geographic area they live in.

The ability of households to insure against shocks in the informal insurance mechanism depends on bonding, bridging, and linking social capitals (Smith et al, 2015). Bonding social capital refers to the linkage between community members with similar socio-economic characteristics. It involves principles and norms such as trust, reciprocity, and cooperation between community members to help each other to cope with and recover from shocks (Smith et al, 2015). Membership on local associations and mutual support are typical indicators of bonding social capital. Bridging social capital connects members of one community to different other communities. It often crosses ethnic (racial) lines, geographic boundaries, and language groups, and can facilitate links to external assets and broader social and economic identities (Wetterberg, 2004). Households and communities who have better external ties and exposure to the wider social world can easily respond to and recover from shocks which often deplete local resources and bonding relationships. The households in the study area, irrespective of their wealth, make great efforts to receive food aid and maximize the quota they receive from the PSNPs. Bridging social capital here refers to membership of households in the formal

government PSNPs. Linking social capital refers to the vertical linkage between households and agents possessing higher authority. It refers to the trust embedded social networks and relations between individuals and groups interacting hierarchically across explicit, institutionalized, and formal boundaries in society (Smith et al, 2015). Linking social capital helps households benefit from resources held by elite agents. Government and nongovernmental organizations deliver capacity building support to households to improve their economic wellbeing in the long-term. This study used capacity building (or training) support household members received and their access to up-to-date information in order to consider the role of linking social capital in the analysis. It used important variables from each of these three categories to measure the stock of social capital.

Methodologically, social capital is the most puzzling concept; hard to clearly measure it because the components embedded on it are nonphysical and difficult to translate into monetary terms (Moser and Felton, 2007). Some studies consider six, sometimes, overlapping dimensions: groups and networks, trust and solidarity, collective action and cooperation, information and communication, social cohesion and inclusion; and empowerment and political action (Dudwick et al, 2006) each of which falls either under bonding, bridging or linking social capital. However, some authors use group membership alone to measure social capital (Grootaert, 2001), others still use an index derived from several sets of proxy variables to measure social capital (Grootaert and Narayan, 2000). Local associations help association members share information, reduce opportunistic behavior and facilitate collective decision making. However, social capital and local associations are not synonyms. Social capital can exist outside the context of local associations and institutions (Grootaert, 2001). Association membership is most often used as a proxy measure of social capital. In the same vein, the study examined membership of farm households in formal and informal local associations such as cooperatives, farmers/women/youth associations, *equb* and *edir*. In fact, the descriptive statistical membership analysis revealed that majority of the households is members of farmer/women/youth| associations (79 percent), cooperative organization (61 percent), and *edir* (57.50 percent) association. Over 86 percent of the studied households are not members of *equb* association. Yet, membership alone does not fully indicate the true function of social capital on food security of households. The study further examined trust, mutual support and exchange, remittances, and decision making power.

Trust is the most difficult concept to comprehend and measure it because it contains different connotations to people who have different cultural and disciplinary backgrounds. Trust refers to the extent to which people feel they can rely on relatives, neighbors, colleagues, acquaintances, and key service providers either to assist them or ensure them not to harm. It is a choice that reflects a necessary dependency based on established contacts and networks (Dudwick et al, 2006). The study administered one nominal and two ordinal questions to capture and better examine the level of community and institutional trust. Collective action and cooperation of one household with the other imply the mutual support and exchange they made in the area. This study used receipt of remittances, wealth heterogeneity, membership in productive safety-net programs, and exchanges of labor (oxen), food (or seed) and money support and exchange households made with their relatives, neighbors and nonrelatives in the area. The study administered a series of dichotomous questions to the respondents to capture this variable. Likewise, access to information and communication helps poor households respond to and recover from shocks and stresses. It also helps households receive up-to-date market information about modern agricultural inputs and technologies, rainfall patterns, crop and livestock disease; saving and credit opportunities which matter for sustaining their livelihoods. This study took access to and ownership of telecom device, access to agricultural inputs and technologies; and market information variables to capture the information and communication dimension of social capital.

Social cohesion and inclusion focuses on the tenacity of social bonds and their dual potential to include or exclude community members (Dudwick et al, 2006). This dimension is manifested through events and activities such as wedding and funerals that increase solidarity and social cohesion; promote civic mindedness and develop a sense of collective consciousness. The study used a series of categorical questions on wedding, funeral and illness to capture the social cohesion and inclusion dimension. The empowerment and political action dimension of social capital explores the sense of satisfaction, personal efficiency and capacity of group members to influence both local and broader political outcomes. It can occur within a small neighborhood association or in a broader local, regional, or national level. The study took five capacity building, four political actions, and one sense of satisfaction (happiness) categorical questions to capture the empowerment and political action dimension of social capital.

There are no clear inclusive or exclusive criteria to include or exclude one or more indicators in each social dimension to measure it. This study used bonding social capital variables such as membership on local associations, trust, mutual support and exchange, decision making power, political participation and happiness. It also included bridging social capital variables such as membership on productive safety-net programs and remittance; and linking social capital such as capacity building (training) and access to up-to-date information. Lastly, MCA analysis was run to generate social capital index. The MCA automatically rejected five of the forty seven social capital variables because they did not vary significantly across the studied households. These variables do not contribute to the food security disparity of households in the area. Six variables were precluded from the MCA analysis because they do not satisfy monotonicity criterion of the model. Thirty six of the examined social capital variables satisfied the MCA monotonicity criterion. The study has finally used (monotonically relevant) thirty six categorical variables to compute the social capital index using equation 4.1. The average social capital index of the households was equal to 0.163. The analysis demonstrates that almost all of the monotonically relevant variables negatively loaded on food security of households. They have little contribution to enhance food security of households in the area.

Table 8: Social asset stock multiple correspondence analysis coefficients

S/No	Social Capital Indicators	Categories	Index Coefficients
1	Contribution to & participation on funeral and mirage	Negative	Does not meet MCA
2	Contribution to & participation in wedding and engagement	Negative	Does not meet MCA
3	Monetary contribution of households to rituals	Negative	Does not meet MCA
4	Chemical fertilizer adoption	Negative	Does not meet MCA
5	Improved seed adoption	Negative	Does not meet MCA
6	Participation of HHs on decisions that matter their livelihood	Negative	Does not meet MCA
7	Cooperative membership	Member	0.376
		Nonmember	-0.589
8	<i>Edir</i> membership	Member	0.492
		Nonmember	-0.666
9	<i>Equb</i> membership	Member	1.907
		Nonmember	-0.298
10	Farmers/women/youth associations	Nonmember	-2.199
		Member	0.585
11	Food/monetary aid households received from GOs and NGOs	No	0.312
		Yes	-0.019
12	Food/seed/money support households received from neighbors and friends	No	-0.666
		Yes	0.679
13	Food/seed/money support households received from relatives	No	-0.514
		Yes	0.629
14	Food/seed/money support households received from nonrelatives	No	-0.481
		Yes	1.207
15	Labor (or oxen) support HHs receive (from relatives) in case of illness	No	-2.676
		Yes	0.409
16	Labor (oxen) support HHs receive (from neighbors and nonrelatives) in case of illness	No	-3.079
		Yes	0.470
17	Urgent food/monetary support households provide to their neighbors/relatives	No	-4.522
		Yes	0.314
18	Urgent food/monetary support households received from their neighbors/relatives	No	-4.274
		Yes	0.285
19	Level of household trust to local government officials	High	0.741
		Medium	-1.093
		Low	-1.285
20	Level of household trust to regional government	High	0.584
		Medium	-1.314
		Low	-0.773
21	Participation on community-based development activities	No	-2.745
		Yes	0.199
22	Adult literacy training	No	-1.738
		Yes	1.099
23	Agricultural extension training	No	-2.991
		Yes	0.216
24	Training on business (entrepreneurship)	No	-1.007
		Yes	1.295
25	Training on early warning	No	-2.019
		Yes	1.136
26	Training on NRM	No	-1.821
		Yes	0.121
27	Training on postharvest handling	No	-2.604
		Yes	0.834
28	Training on marketing	No	-0.368
		Yes	2.214

29	Public petition collection	No	-0.360
		Yes	1.727
30	Level of household safety from crime and violence	Very safe	0.421
		Medium	-0.829
		Unsafe	-2.069
31	Happiness of household members on their livelihood (life)	Very happy	1.204
		Moderately happy	-0.433
		Unhappy	-7.396
32	Public telecommunication access	Inaccessible	-0.010
		Accessible	0.149
33	Cell phone ownership	No	-3.376
		Yes	0.254
34	Weather information	Inaccessible	-0.495
		Accessible	1.834
35	Rainfall information	Inaccessible	-4.540
		Accessible	0.226
36	Crop disease information	Inaccessible	-2.669
		Accessible	0.537
37	Livestock (animal) diseases (health) information	Inaccessible	-3.748
		Accessible	0.548
38	Livestock improved breeds information	Inaccessible	-2.716
		Accessible	1.150
39	Livestock and grain market information	Inaccessible	-3.561
		Accessible	0.248
40	Agricultural technologies/inputs information	Inaccessible	-4.450
		Accessible	0.173
41	Saving and credit information	Inaccessible	-2.925
		Accessible	0.547
42	Human health information	Inaccessible	-2.719
		Accessible	0.406

Source: Author computation, 2018

4.2.5. Financial Asset Endowment Analysis

Financial capital refers to the readily available financial assets; livestock and house equity households can easily convert into monetary value when they need it (Carney, 1998). It is the most versatile asset which can easily be converted into other forms of capitals and enable households directly achieve their desired livelihood outcomes. It is, however, the least available asset to the poor (DFID, 1999) especially in developing countries where the assets are usually physical and not easily quantified in monetary terms (Moser and Felton, 2007). This study has divided the financial capital into saving, credit and income categories.

Saving is the most preferred financial capital because it does not have liabilities attached and does not entail reliance on others (DFID, 1999). It can be held in cash and bank deposits or more liquid physical assets. Saving financial asset category here comprises livestock, jewelry,

and cash in hand and bank account, and (grain) storage. Livestock production is the second most important agricultural activity in rural Ethiopia. Livestock do have multipurpose asset form. They provide food, security, enhance crop production, generate cash incomes, fuel and transport and produce value added goods which can have spillover effects on household livelihoods (Sere` and Steinfeld, 1995). They are also a means of food security during crop failure and other calamities (Haile et al., 2005). Households who own large numbers of livestock are expected to be invulnerable and resilient to food insecurity and vice versa. This study first aggregated the livestock asset portfolio in each household using Tropical Livestock Unit conversion factor (Storck, et al., 1991) and then transformed it into categorical variable for the ease of MCA computation. The descriptive statistics revealed that majority of the households owned one or more type of livestock. Only 10.5 percent households did not have any type of livestock in the survey time. The households, on average, had 3.88 livestock during the survey time. Similarly, Tigray women wear ornaments and jewelry made of gold and silver. In addition to beautification, jewelries are a typical capital reserve mechanism and ramification of household wellbeing in the area. The study considered gold and silver jewelry ownership as a typical discriminatory factor in the financial capital index calculation. It also included cash savings and grain storage to compute the saving dimension of the financial capital index.

It has long been recognized that credit is a powerful financial instrument to lift the rural poor out of abject poverty (Doreen and Philip, 2014). Credit enables households to increase their agricultural productivity through adoption of modern agricultural technologies and inputs (Zeller and Sharma, 2000). The credit package provision in the area includes livestock, small animals, poultry, beehives, seed and fertilizer, and seed money (Tagel and Veen, 2010). However, most poor households have limited access to formal financial services to-date. This is because the rural poor households lack collateral, steady employment, verifiable credit history, and other requirements necessary to gain access to formal credit (Bauchet et al., 2011). Rural households usually rely on a variety of informal credits such as local moneylenders, relatives, friends, or merchants. Such informal credit services may be neither reliable to access nor have affordable interest rates. The credit financial asset category here constitutes the sum total of cash credit (from relatives/friends/neighbors), agricultural loans (livestock hybrid, improved seed, and fertilizer), and cash loans the household borrowed (from banks, microfinance institutions, and credit cooperatives). In fact, the result of the descriptive statistics revealed that over 97 percent of the households had access to financial institutions in the survey year. The

households had, on average, borrowed Ethiopian Birr 5923 five years prior to the survey year from both formal and informal sources. This average credit was equivalent with USD 245.34.

The income dimension of financial capital in the study refers to the regular inflows of money households reap from all agricultural and nonagricultural sources. It refers to the total cash income households earn from agricultural and nonagricultural sources. The agricultural income refers to the cash income households earn from cash crops (such as hop plant, vegetables and fruits), livestock and livestock byproduct sale. The nonagricultural income referred to all other sources of income including state transfers and aids, pensions, remittances/subsidies, wage income, weaving, petty trade, firewood and charcoal selling, and stone vending. The total average income of the households was Ethiopian Birr 24516 per year. This annual average income was equivalent with USD 1015.6. The per capita income was about Ethiopian Birr 4027 per year. This means, on average, each household member earns around 166.8 USD per annum. This per capita income per day is much less than the internationally accepted level (1.25 USD per day) of income household members should have to earn to be 'non-poor'. This per capita income roughly signifies that most households in the area are poor and food insecure.

The study examined a total of eleven categorical variables to compute the financial capital stock of households in the area. The MCA model, unfortunately, rejected such important financial capital variables as annual household income, bank account, gold jewelry ownership (but not silver), human health and crop failure insurance, grain storage, and number of livestock from the analysis because they did not satisfy the monotonicity criterion of MCA analysis. These financial factors are contributing contrary to the classical conviction that access to and accumulation of such financial resources as cash income, bank account, gold jewelry, human health and crop failure insurance, grain storage, and livestock plays pivotal role to enhance food security of households. It is important to note that the cash income households earn basically goes to nonfood expenses. Similarly, women in the area rarely sell the gold jewelry they accumulate due to the cultural taboo. Gold jewelry accumulation also intensifies food insecurity. The human health insurance fee households pay to the government did not bring about commensurate health service so far. The focus group discussants complain about the health insurance service delivery in the area. Large livestock herd rearing in the area is obstructive to enhance food security of households due to (1) shortage of grazing land; (2) expensive supplementary feed; (3) shortage of shepherd; and (4) covariate shocks. Only silver

jewelry ownership, cash saving, and credit financial asset factors met the MCA monotonicity (increasing order of importance) criterion. The study used these three variables to compute the financial asset index using equation 4.1. The average financial capital index of the households was equal to 0.038. This minimal financial index score demonstrates that financial resources are the least readily available in the area. The financial asset MCA analysis further demonstrates that silver jewelry accumulation and cash saving financial factors are positively loading on food security of households. Credit households borrowed from formal and informal institutions, unexpectedly, contributes little to enhance food security in the area.

Table 9: Financial asset stock multiple correspondence analysis coefficients

	Financial Capital Variables	Financial Capital Categories	Index Coefficients
1	Bank account of household members	Negative	Does not meet MCA
2	Gold Jewelry ownership	Negative	Does not meet MCA
3	Human health insurance	Negative	Does not meet MCA
4	Crop insurance	Negative	Does not meet MCA
5	Grain storage in the household	Negative	Does not meet MCA
6	Number of livestock households own	Negative	Does not meet MCA
7	Average annual income households	Negative	Does not meet MCA
8	Cash saving households held	Below average household savings	-0.862
		Above average household savings	1.969
9	Cash credit households borrow	HHs who borrowed below average	0.456
		HHs who borrowed above average	-0.885
10	Silver ownership	Does not own	-0.310
		Owns	2.901

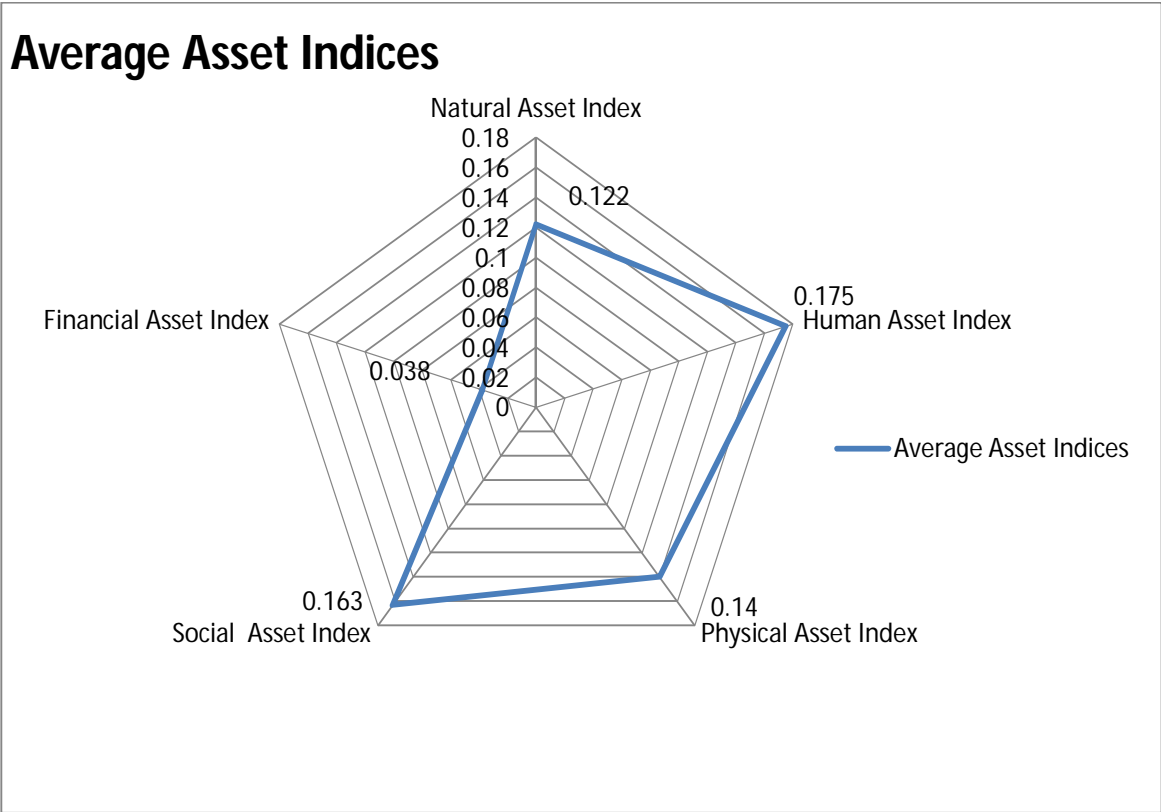
Source: Author computation, 2018

4.2.6. Livelihood Asset Pentagon

The study estimated the five asset categories of rural livelihoods using MCA. The indicators and variables in each asset categories are of different kinds of things and measured in different ways and on different scales. Hence, the researcher (1) identified the relevant variables of each asset; (2) measure each of asset categories independent of the others using different scales and scores; and (3) calculated the total score for each asset type using MCA. The study finally summed each asset category index scores up to determine the total asset index of the sampled households in the *Wereda* using $THAIs = \frac{(CPI+CNI+CHI+CFI+CSI)}{5}$ where THAIs denotes Total Household Asset Index; CPI, CNI, CHI, CFI and CSI represents physical capitals, natural capitals, human capitals, financial capitals, and social capital values of the livelihood assets of the households respectively.

The researcher summarized the livelihood asset stock of the households in the area using an asset pentagon to easily portray the variation of access to different asset types between the studied households. The shape of the pentagon summarized the variation of access to different asset types for an average household. The central point of the pentagon represented zero access to assets while the outer perimeter represented maximum access to assets. In fact, asset index scores close to zero demonstrate low asset endowment while asset index scores close to one imply high asset endowment of households. The average livelihood asset index of the households was equal to 0.127. This small livelihood asset index figure shows that the sampled households have low stock of livelihood assets making them vulnerable to multitude of natural and manmade shock factors and undesirable livelihood outcomes. On one hand, the pentagon reveals that human capital and social asset are relatively abundant in the study area. On the other hand, the pentagon depicts that financial and natural assets are the least readily available livelihood resources in the area.

Figure 4: Livelihood Asset Pentagon



Source: Author`s computation

4.3. Chapter Summary

This chapter measured the livelihood asset endowment of households using asset index. Indices close to zero imply low asset endowment while index scores close to one imply high asset endowment of households. The average livelihood asset stock of the households was equal to 0.127. The disaggregated livelihood asset endowment analysis reveals that human capital and social assets are relatively abundant in the area. Conversely, the study indicates that financial and natural asset are the least readily available livelihood resources in the area.

The natural asset endowment analysis reveals that only land acquisition, land quality, land convenience, and hop plantation are important natural asset differentials in the area. The study further demonstrates that almost all households have access to land either through land distribution, redistribution, inheritance and other means of land transaction. However, agricultural land ownership does not significantly vary across the studied households in the area. The result of MCA analysis demonstrates that farm holding size does not create food security disparity between households. The water resources endowment and development varies across the agro-ecology of the study area. There are relatively abundant surface and ground water resources in the highland and midland areas of the *Wereda*. Contrary, there exists surface and ground water scarcity in the lowland agro-ecological zone of the study area. The study found that majority of the studied farm households had no access to irrigation. The rural poor started generating income from firewood and charcoal, cactus, eucalyptus and hops selling.

This study used such important factors as gender, age of the head, education, health condition, family size, labor adequacy, dependency ratio and training to measure human asset index. The result of the analysis demonstrates that gender inequality, family breakings, illiteracy, poor health, small family size and lack of training adversely affects food security of households. The physical asset analysis constitutes nonproductive, productive assets, housing and basic public services asset categories. The descriptive statistics analysis reveals that households had good stock of consumer (utensils) goods, basic agricultural implements and tools; potable water points, public transport, access to primary school and health posts; veterinary services, financial institutions, and agricultural extension services. The analysis, however, proves that the households lack access to and control over modern house appliance, modern agricultural productive technologies and tools. It further demonstrates that road networks, secondary and

preparatory schools, telecom services, electricity infrastructure, and alternative cooking energy provision are poor in the area.

The financial asset comprises income, saving and credit categories. The financial asset analysis rejected such important variables as annual household income, bank account, gold jewelry ownership, health insurance, crop failure insurance, grain storage, and livestock from the analysis because they did not satisfy the monotonicity criterion of MCA analysis. These financial factors are contributing contrary to the classical conviction that access to and accumulation of such financial resources play pivotal role to enhance food security of households. The financial asset analysis demonstrates that silver jewelry accumulation and cash saving are positively fostering food security of households in the area. Conversely, the analysis confirms that the credit households borrowed from formal and informal institutions are unhelpful to reduce food insecurity in the area.

5. MULTIDIMENSIONAL FOOD SECURITY ANALYSIS

5.1. Introduction

Food insecurity leads to substantial productivity losses and misallocation of scarce resources. It consequently lowers cognitive development and school performance of people and makes them take inefficient decisions on their daily lives (Pérez-Escamilla and Vianna, 2012). Pérez-Escamilla and Vianna underscore that food insecurity affects the physical, mental, social, and psych-emotional development of a child through biological and psycho-emotional pathways. In fact, the United Nations has long declared that everyone has the right to a basic standard of living: including food, clothing, housing and medical care (UN, 2015). Today, the world (or mankind) has the ability to produce enough food for all its inhabitants (OXFAM, 2009). Indeed, famine and food insecurity are not acceptable (WFP, 1996; Sarracino, 2010). Food security has got over 200 definitions in the literature. This plethora of terms used to discuss food security obscures what exactly food security means and how it is measured (Jones et al, 2013; Maxwell, Coates and Vaitla, 2013). It is, however, unnecessary to redefine it here.

This study adopts the WFP (1996) definition of food security which refers to “The physical and economic access at all times to sufficient, safe and nutritious food to meet the dietary needs and food preferences for an active and healthy life.” On the other hand, food insecurity refers to “A situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life.” This WFP (1996) definition of food security includes the availability, access, utilization and stability dimensions without which it is impossible to ensure and measure food security. It is also important to note that the stability dimension of food security is crosscutting and applicable to all the other three dimensions (Maxwell and Frankenberger, 1992).

5.2. Food Security Dimensions

Food security is a multidimensional concept which cannot be captured by a single indicator. There is no agreement amongst scholars regarding the standard definition of food security nor are there standard food security metrics. The definition of food security, a study adopts, influence the metrics used to measure food security. That is when dimensions of food security differ; metrics and indicators used to measure them differs (Alnafissa, 2017). The most cited

definition of food security constitutes (1) the availability of and access to sufficient amount of food (i.e. that people have enough food to meet their energy [calorie] requirements); (2) the availability of and access to different types of food to ensure adequate diet quality (or that people are able to meet their protein and micronutrient requirements); (3) the absence of feelings of deprivation, restricted choice or anxiety related to the quantity or quality of available food (psychological dimension); and (4) the sociocultural acceptability of consumption patterns (WFP, 1996; and Barrett, 2002). This section highlights the core dimensions (availability, accessibility, utilization and stability) of food security.

Availability Dimension of Food Security: Food availability refers to the quantity of food available in a country or region [village/household] through all forms of domestic production, commercial imports, food stocks and food aid (USAID, 1992; WFP, 2009). This dimension captures the physical availability of food, and includes all kinds of food irrespective of their sources. Food security metrics should hence constitute indicators that capture the availability dimension of food security.

Accessibility Dimension of Food Security: Household food access refers to the physical and economic ability to acquire sufficient quantity and quality of food to meet all household members` nutritional requirements for productive lives (Swindale and Bilinsky, 2006). It refers to the socio-cultural, physical and economic/financial access of people to the available food. It represents the demand side of food security, including the physical and the economic endowment of people to access the food available in the economy (Napoli, 2011). The physical access to food refers to lack of food in a world with abundance of foodstuff due to poor infrastructure development and road networks. From economic perspective, people access food only if they have economic ability to afford sufficient food because food shortage can occur without any physical food supply decline over time if market prices sharply rise (Sen, 1981b). It has been ascertained that the presence of enough food per capita at national level is merely a necessary, but not sufficient, condition for food security (Burchi and Muro, 2012). The socio-cultural dimension of food access ascertains that the physical availability of food and the presence of effective demand do not guarantee food security. Public (cultural) food preferences, political crises and other manmade crises, such as hoarding, may still disrupt access to food. Food security metrics should thus constitute indicators that capture the accessibility dimension of food security.

Utilization Dimension of Food Security: The availability of, and access to, food are necessary but not sufficient to enable people to secure safe and nutritious food. Utilization in the context of food security refers to the biological capacity of the individual to make use of food for productive life (Swindale and Bilinsky, 2006). It refers to proper food usage, processing and storage, the existence of adequate knowledge of nutrition and child care techniques; and adequate health and sanitation services (USAID, 1992). It also refers to food allocation within households, the nutritional quality of that food and household members' absorptive and metabolic ability to utilize the nutrients available in that food (Jones et al, 2013). In other words, the food people consume has to provide them with sufficient energy and micro-nutrients to enable the consumer to carry out routine physical activities (Napoli, 2011). This utilization dimension of food security captures the effective use of available food in terms of nutritional value, hygiene, and food safety. It also covers safe drinking water and adequate sanitary facilities to avoid the spread of diseases and awareness of food preparation and storage procedures. Utilization covers a range of factors hinging on understanding of what foods consumers have to select and how they should prepare and store food items (Napoli, 2011). Food security metrics should thus include indicators that capture the utilization dimension of food security.

Stability Dimension of Food Security: The phrase "at all times" in the standard WFS (1996) definition of food security introduces the sustainability dimension of food security pointing to the need for understanding both current and future food security dynamics of households (Babatunde et al., 2008). In other words, the stability domain of food security intrinsically determines the future food security fate of households. It is also important to note that the stability dimension is a crosscutting and applicable to availability, accessibility and utilization dimensions of food security. Stability of food security here refers to the sustainable supply, access and utilization of food by all people at all times. Food security metrics should hence include indicators that capture the stability dimension of food security.

This chapter intends to analyze multidimensional food security status of households using multidimensional food security indicators. The indicators constitute the four dimensions of food security each measured independent of the others. The four dimensions of food security categorically represent the supply and demand side of physical and economic variables. The availability and stability dimensions of food security usually represent the supply side factors.

The accessibility and utilization dimensions represent the demand side factors. The study assumes that the multidimensional food security status of each household is the resultant outcome of the pattern of twenty-four indicators capturing all food security dimensions. Each indicator captures a different food security construct. The authors who developed multidimensional food security indicators run comprehensive statistical correlation tests. They only retained indicators that are uncorrelated and rejected correlated indicators in their analysis.

The dimensions of food security, implicitly or explicitly, have a hierarchical order where adequate security of one dimension does not guarantee security in another (Napoli, 2011). Napoli added that food security does have a physical determinant (availability, access and utilization) and temporal (stability) determinant. There may be adequate food at national, local or household level but that availability does not guarantee food access. Likewise, households may have secure access to food but that does not guarantee their proper food utilization. Furthermore, stability or the lack of it can affect one or all dimensions of food security (Napoli, 2011). The next section examines the popular food security metrics and draws a concluding remark on the need to adopt multidimensional food security indicators to measure household food security in totality.

5.3. Selection of Food Security Indicators and Metrics

Food security measurement has long been fraught with methodological challenges (Wiesmann et al, 2009). A number of metrics used to measure food security at global, national, regional, household and individual levels have been circulating in the literature. Some metrics focus on one dimension out of food availability, access, utilization, and the stability of food security over time. Others do try to combine the dimensions of food security in various ways to produce a composite index of food security (Cafiero et al, 2014). They also vary from simple indicators for which data can be quickly collected and easily analyzed to comprehensive measures that require detailed, time and resources intensive data collection and sophisticated statistical analysis. Furthermore, food security metrics may claim to capture hypothesized causes of food insecurity or consequences of it (Jones et al, 2013). Using particular indicators implies different notions of the construct of food security being measured. It is therefore important, in principle, to first examine each of the available indicators and adopt appropriate metrics that measure the construct of your interest (Cafiero et al, 2014). In fact, the validity of food security metrics depends on the underlying constructs and purposes it intends to measure. Selection and

application of inappropriate metrics could lead to: (1) measuring unintended domains of food security; (2) double counting of food security domains; (3) irrelevant data collection and usage; (4) data collection on an inappropriate scale and inappropriate time intervals; and (5) selection of a tool that requires resources beyond the available ones (Jones et al, 2013).

This section presented the popular food security indicators to draw appropriate metrics used to measure multidimensional household food security. These food security indicators can broadly be categorized into food consumption adequacy metrics and direct experience and behavioral based measures of severity of food insecurity. The food consumption adequacy metrics usually measure food availability at national level while the direct experience and behavioral (perception) based indicators usually measure severity of food insecurity at household and individual levels (see the next section).

5.3.1. National Food Security Indicators

Food security indicators used to estimate national food security often put emphasis on food availability. Such national food availability measurement began well before scholars recognized and refined the concept of food security (Jones et al, 2013). The international community began to collect national food balance sheet data to facilitate food allocation and distribution in 1940s and 1950s (FAO, 2001). This national food balance sheet measures the total quantity of calories available to a population in the form of foodstuffs produced or imported into a country. This food security metrics implicitly prioritizes national availability of food supplies to determine national food security situation (Jones et al, 2013).

This food balance sheet drawn from nationally aggregated data on food supply has been used to measure the prevalence of undernourishment in the food security metrics of FAO. That is FAO (1989) prevalence of undernourishment measures food security as the fraction of the population with per capita energy consumption below the standard nutritional requirements for an active and healthy life (FAO, 2014). Today, FAO publishes prevalence of undernourishment food security estimates annually using a total of 26 indicators (Jones et al, 2013). However, the FAO prevalence of undernourishment index unsatisfactorily predicts growth failure, mortality and economic productivity. Moreover, the index does not detect food distribution nor does it detect food deficiency changes specifically for the most deprived sector of the population (Svedberg, 2000; Masset, 2010).

Likewise, the IFPRI Global Hunger Index measures hunger at global, national and region level (Wiesmann, 2006). In the GHI, the term “hunger” is used to reflect severe food insecurity. GHI is a multidimensional statistical tool used to describe the state of national hunger situation of countries. It measures food security indirectly using three equally weighted indicators: undernourishment (the proportion of undernourished people as a percentage of the population); child underweight (i.e., the proportion of children under 5 who have a low weight for their age); and child mortality (i.e., the mortality rate of children under 5) (IFPRI, 2014). The index highlights successes and failures in hunger reduction and provides insights into the drivers of hunger. It also creates awareness and understanding of regional and country hunger rates disparities (Wiesmann, 2006, IFPRI, 2014). The index ranks developing countries into serious problem, alarming, and extremely alarming categories based on arbitrarily selected cut-off point values (Masset, 2010). Furthermore, the USAID famine early warning system network and the WFP vulnerability analysis and mapping methodology are used to predict and monitor food security in food insecurity prone regions (Jones et al, 2013). These aggregate food security metrics do not capture all dimensions of food security nor household level determinants of food security. But food security indicators used to measure food consumption adequacy at disaggregated household/individual level cannot be subjected to statistical analytical and empirical food security metrics validation tests of representativeness (Cafiero et al, 2014).

5.3.2. Household Food Security Indicators

Though food availability remains a fundamental dimension of our current food security understanding, the conventional national food security metrics do not capture the utilization, accessibility and stability dimensions of food security nor household level food security behaviors. Amartya Sen (1981b) who pioneered the entitlement approach asserts that food shortage can occur without any food supply decline over time since market prices can sharply rise over time. Sen argued that the poor may lack effective demand to purchase food even if national food supplies are sufficient.

It has ascertained that the presence of enough food per capita at national level is merely a necessary but not sufficient condition for food security (Burchi and Muro, 2012). Likewise, micronutrient under-nutrition became the primary focus of nutrition research in the mid-1990s (Jonsson, 2010). The WFP on its world hunger series (2007) defines under-nutrition as the physical manifestation of hunger that results from serious deficiencies in one or more of

macronutrients and micronutrients. The deficiencies impede a person from maintaining growth, pregnancy, lactation, physical work, cognitive functions, and resisting and recovering from disease. Since then, food utilization became a third dimension of food security which recognizes physical and economic access to food and food acquisitions are necessary but not sufficient to ensure food security for households (Jones et al, 2013).

Food security is a multidimensional concept. The WFP (1996) definition of food security constitutes not only the availability, accessibility and utilization dimensions of food security but also the ability to acquire socially and culturally acceptable food bundles (Jones et al, 2013). It also incorporates the phrase “at all times” pointing out the necessity of food security stability over time. This entitlement narrative has contributed to the development of new versions of metrics that measure food security at household and individual level. For example, the age-adjusted per-capita caloric intake and anthropometric measures of nutritional status have been considered the gold standard measures of food access at household and individual level, respectively for many years (Hoddinott and Yohannes, 2002; Weismann et al., 2006; Coates et al., 2007). However, these household food security metrics actually measure either food acquisition (food consumption) or limited food security dimensions. For example, anthropometric indicators essentially measure food utilization (Swindale and Bilinsky, 2006; and Coates et al., 2007). They estimate the allocation of food within households (i.e. the quantity and kind of food household members consume); the nutritional content and quality of that food. Food allocation within households may be unrelated to nutritional needs and may result in nutritional deficiencies for one or more household members (Haddad and Kanbur, 1990). They may also be used to measure the consequence of food insecurity such as mortality (Pelletier et al, 1995); and morbidity, cognitive development, and chronic disease (Martorell and Haschke, 2001). Anthropometric indicators commonly use proxy measures such as low weight-for-height (wasting), low weight-for-age (undernourished), and low height-for-age (stunting) of children under the age of five to estimate the consequence of food insecurity (Napoli, 2011).

Household food consumption and expenditure surveys are also applied to estimate food poverty among households. However, household food consumption and expenditure surveys usually measure food availability which does not necessarily measure actual nutritional intakes. They do not account for individual food consumption, or do they differentiate between wasted or

consumed food items (Jones et al, 2013). Moreover, these conventional household food security measures are not only technically difficult, but also they do not capture all the dimensions of food security (Coates et al., 2007). Neither of these metrics measures the accessibility component of food security. A number of measures that can capture the accessibility component of food security have been developed over time.

5.3.2.1. Household Dietary Diversity Score (HDDS)

Household Dietary Diversity Score (HDDS) is a proxy measure of adequacy of food consumption at household level (Cafiero et al, 2014). It is defined as the simple count of the number of food groups consumed in a defined reference period (Kant et al, 1993). It measures household access to diverse nutritious food items. Household dietary diversity is an attractive proxy indicator of food access because a more diversified diet is strongly associated with physical food security outcomes such as birth weight, child anthropometric status and hemoglobin concentrations. It is also highly correlated with calorific and protein adequacy, livestock sources (quality protein) and household income. The indicator focuses on the number of different food groups consumed rather than the number of different foods consumed. The indicator has two versions: Individual and Household Dietary Diversity Score (IDDS and HDDS). Both of them capture the number of different food groups individuals and households consume over a given reference period. The score of the indicator can be computed by summing up equally weighted response data on the consumption of 12 food groups (i.e., cereals, roots and tubers, vegetables, fruits, meat, eggs, fish/seafood, pulses/legumes/nuts, milk/milk products, oils/fats, sugar/honey, and other miscellaneous) (Swindale and Bilinsky, 2006).

For example, the individual responsible for food preparation in the household is asked if anyone in the household consumed any item from the food group in the previous 24 hours. These responses are summed to obtain a score from 0 to 12. However, the diversity of food items available to households varies across cultural contexts. Hence, there is no unique definition of acceptable dietary diversity for all settings. That is, household food security measurement across settings using dietary diversity indicators does not represent the same underlying phenomenon in terms of desirable diet (Jones et al, 2013). The dietary diversity score has no standard cutoffs for defining food insecurity (Swindale and Bilinsky, 2006). Moreover, the indicator does not capture the accessibility and stability of food security dimensions nor it

captures coping strategies households take in times of food shortfall. HDDS therefore does not qualify to measure multidimensional household food security.

5.3.2.2. Food Consumption Score (FCS)

WFP (2007) established FCS to measure food security status of countries/regions/population groups within countries relative to others for the ease of international food program targeting, calculation of food needs of a food insecure population group and food rationing. FCS is a proxy measure of food frequency (quantity) and dietary diversity (food quality) households consume. In other words, FCS is used to estimate diet quantity (calorie consumption per capita) and diet quality dimensions of food security (Wiesmann et al, 2009). The indicator intends to estimate whether the household manages to access sufficient items from the basic food groups in its habitual diet. It measures a simple count of food groups that members of the household have consumed over the preceding seven-day recall period. The number of days of consumption of each food group in the reference last seven days is intended to track potential irregularities in consumption.

The FCS score is a quantitative measure of food consumption that reflects household access to a wide variety of foods (FAO, 2008). The FCS module constitutes 8 food groups: cereals; starchy tubers and roots; legumes/nuts; meat/fish/poultry/eggs; vegetables; fruit; oils/fats; milk and milk products; and sugar/oil. It also accounts for food items that are consumed in very small quantities. The FCS is a frequency-weighted diet diversity score (food frequency indicator). The weights are supposed to make the FCS more capable of capturing the diet quality and diet quantity dimensions of food security (Wiesmann et al, 2009). The respondent reports on the frequency of household consumption of each of these food groups. The frequency of consumption of each food group is then multiplied by an assigned weight for each group and the resulting values are summed to obtain the FCS. FCS is thus calculated using the frequency of consumption of 8 food groups consumed by a household during the seven days before the survey. This FCS score is then recoded to a categorical variable using appropriate threshold (cutoff values) to categorize households into groups of poor, borderline and acceptable food consumption households. FCS also helps us assess the linkage between dietary diversity and household food access (WFP, 2007). However, it does not capture all dimensions of food security.

The HDDS and FCS do share a common emphasis on dietary diversity as a proxy measure for household food access (Jones et al, 2013). Jones et al underlined that FCS and HDDS metrics differ in their recall period, the number and definition of food groups, the weighting of food groups, the cutoff points for defining food-insecure households, and the combination of food frequency information with dietary diversity data. The authors emphasize that FCS and HDDS require relatively low cost data collection and may be useful for monitoring food security programs despite the trade-offs in using the indicators (Jones et al, 2013).

5.3.2.3. Household Food Insecurity Access Scale (HFIAS) and HHS

The Food and Nutrition Technical Assistance Project of the USAID developed HFIAS to measure food access experience of households (USAID, 1992). HFIAS is essentially constructed to measure the access dimension of food security. It is made up of nine generic questions used to assess food security experiences and perceptions of households. In other words, the HFIAS questionnaire consists of nine occurrence questions identifying hierarchically increasing levels of severity of food insecurity (food access); and nine follow up “frequency-of-occurrence” scores to each of the nine qualitative occurrence questions to quantify how often the condition occurred. The interviewer must skip the frequency-of-occurrence question unless the respondent reports that the household experienced the food insecurity condition described in the corresponding occurrence question in the previous 30 days (Coates et al., 2007). HFIAS generates a single aggregate score ranging from 0 to 27 to measure household food security status. This score in turn is used to identify food insecure households and target programs designed to reduce the number of food insecure households. It captures feelings of uncertainty and anxiety over food, perceptions of insufficient quality and quantity of food, reductions in food intake and its consequences for the household including feelings of shame. In other words, the indicator captures households’ behavior signifying insufficient quality and quantity, as well as anxiety over insecure access. The HFIAS generic questions represent universal domains of household food insecurity (access) experience and can be used to assign households along a continuum of severity from food secure to severely insecure.

The rationale behind HFIAS is that experiencing food insecurity causes predictable reactions that can be captured, quantified and presented on a severity scale (Coates et al., 2007). All the generic questions in the scale reflect only the availability dimension of food security (one-dimensional) in that the indicator does not capture and measure utilization (quality) and stability

of food intakes households have over time. Nor does it constitute resource augmentation coping strategies households take in times of food shortfall (Coates et al., 2007). Yet, resource augmentation coping strategies of households provide us with an important element in the full picture of household food insecurity experience in a particular context. HFIAS thus lacks some of the necessary measures to capture the multiple dimensions of household food security.

The Household Hunger Scale (HHS) is an extension of HFIAS. It consists of [the final] three [HFIAS] questions and three frequencies that allows for estimating the percent of households affected by three different severities of household hunger: 1) little to no household hunger; 2) moderate household hunger; and 3) severe household hunger (Deitchler et al., 2011). It measures the most extreme consequences of food insecurity. The new 3-itemscale of HHS (which now includes only 3 frequencies responses-never, sometimes/rarely or often rather than the 4-itemscale recommended in HFIAS) has the highest internal, external and cross cultural validity among the various scales tested. This is because HHS measures extreme manifestation of hunger which is easily recognizable across most cultures (Deitchler et al., 2011; and Jones et al., 2013). HHS here in our study was amalgamated to MFI to capture the presence or absence of the extreme hunger condition households may experience.

5.3.2.4. Coping Strategy Index (CSI)

WFP and CARE developed CSI to measure what people do when they cannot have access to enough food in developing countries. This food security indicator basically relies on and measures behavioral responses (coping strategies) which households take to manage food shortages. It is simpler to understand and used to collect information on coping strategies than other food consumption adequacy indicators (Maxwell and Caldwell, 2008). It simply counts the frequency and severity of behaviors in which people engage when they do not have enough food or enough money to buy food. The index constitutes a series of questions about how households manage to cope with a shortfall in food for consumption and results in a simple numeric score. In other words, the CSI is constructed from a list of coping strategies households rely on in times of food deprivation. The highest coping strategy index households score, the less food secure they are. The CSI score is then used to target households who need food aid and monitor the impact of food aid programs on the livelihood of the beneficiaries (Maxwell and Caldwell, 2008).

The coping strategies households pursue are hierarchically ordered based on their reversibility and commitment of domestic resources (Watts, 1983). Modest dietary adjustments are easily reversible strategies that do not jeopardize long-term household livelihoods. On the other hand, more extreme coping strategies people take suggest more serious (adverse) long-term livelihood consequences (Maxwell and Caldwell, 2008). However, the lists of generic coping strategy questions are not the same across contexts and are often generated through focus group discussions with stakeholders who represent the population of interest (Jones et al, 2013). The next Table (10) compares the popular food security metrics examined above.

Table 10: Summary of food security indicators

Indicators	Main indicators	Unit of analysis	Recall period	Food Security Dimension
1 FAO Prevalence of Undernourishment	Energy intake (per capita calorie intake)	Nations/regions	One year	Availability
2 Global Hunger Index	Percentage of population undernourishment, child underweight and child mortality rate	Nations/regions	Periodically	Availability & utilization (quantity/quality)
3 Household income and expenditure survey	Household energy intake	Households	A few days	Availability/utilization (quantity/quality)
4 Anthropometry	Underweight/ stunting/wasting	National/HHs /individuals	Periodically	Availability and utilization (quantity/quality)
5 Food Consumption Score	A normative threshold (food consumption adequacy)	Nations/population group	7 days	Availability and utilization (quantity/quality)
6 Household Dietary Diversity Score	A normative threshold (of food consumption adequacy)	Households	24 hours	Availability and utilization (quantity/quality)
7 HFIAS Score	A normative threshold of food insecurity (uncertainty/anxiety/shame)	Households	30 days	Accessibility
8 Household Hunger Scale	A normative threshold of hunger (extreme food insecurity)	Households	30 days	Accessibility
9 Coping Strategy Index	A normative threshold of adaptation strategies	Households	Round estimate	Accessibility

Source: FAO (2014); IFPRI (2014); Cafiero et al. (2014); Swindale and Bilinsky (2006); WFP (2007); Wiesmann et al. (2009); Coates et al. (2007); Maxwell and Caldwell (2008)

None of the above (Table 10) indicators sufficiently captures all dimensions of food security. Put it differently, each of the above popular indicators of food security tends to capture data on a single dimension of food security at a time (Weismann et al., 2006). That is no single indicator captures all dimensions of food security to measure it in totality. Moreover, the different measures capture different food security dimensions and classify food-insecure households quite differently (Maxwell et al., 2013). Maxwell et al underscored that food security measurement using only one indicator leads to misclassification of a substantial proportion of households either food secure or food insecure compared with measurements of other indicators. They found that 27 percent of the surveyed households were misclassified

either into food secure or insecure by measurement of another indicator. This study adopts Multidimensional Food Security Indicator (Maxwell et al., 2013) to capture and measure the multiple dimensions of food security. This multidimensional food security metric sufficiently qualifies the validity and reliability axioms of measurement and it produces comparable findings over time and space. The indicator, more importantly, captures the multiple dimensions of food security at a time.

5.4. Multidimensional Food Security Indicator (MFI)

5.4.1. The Concept of MFI

The MFI indicator is a composite indicator made up of (1) HFIAS, (2) HHS, (3) HDDS, (4) FCS, (5) SAFS, (6) CSI, and (7) rCSI. Categorically, HFIAS, HHS, CSI, rCSI, and SAFS higher score indicates greater food insecurity, whereas higher HDDS and FCS scores indicate greater dietary diversity and food frequency and, thus, less food insecurity. MFI captures all dimensions of food security. It measures daily food consumption patterns, food consumption increasing behaviors, dietary change preferences and high value foods consumption behaviors, rationing strategies, rare behaviors in severe conditions, and stability (Maxwell et al., 2013). Unlike the stand-alone indicators, the MFI measures food security status of households in totality. It also measures household food security in accordance to the standard WFP (1996) definition of food security.

Maxwell et al. (2013) validated the MFI indicator in a field study conducted to measure multidimensional food security status of households in eastern Tigray state. The indicator intends to measure the severity and prevalence of household food security. The indicator categorizes households into food secure, mildly, moderately and severely food insecure categories. It also places each household in a single, unique category based on the set of frequency of occurrence responses they provide to each question in the MFI questionnaire. The MFI questionnaire constitutes a set of 24 composite questions categorized by dimension (see appendix I). Each question in the indicator captures a different food security construct. The questionnaire has frequency-of-occurrence questions, which asks how often a reported condition occurred during the previous four weeks. Each frequency-of-occurrence question asks the respondent how often the condition reported happened in the previous four weeks. The questionnaire has four response options representing a range of frequencies (Never, Rarely, Sometimes, and Often). The response option ‘Never’ refers to the non-occurrence of the

condition reported; Rarely implies the condition has happened once or twice in the past four weeks; Sometimes implies the condition has occurred three to ten times in the past four weeks; and the response option 'Often' refers to more than ten times occurrence of the condition in the past four weeks. However, the exact meaning of each frequency response differs by question (Maxwell et al., 2013). The response 'often' to question number one for example has a negative implication and places a household into a severely food insecure category. The same response to question number 24, however, has a positive meaning and may move households towards a more food secure overall category.

The MFI uses an algorithmic means of classification based on HFIAS category construction methodology using the questions to divide households into severely, moderately and mildly food insecure and food secure categories. Each question except the self-assessed food security indicator can be answered from a set of four frequency of occurrence responses borrowed from the HFIAS: often, sometimes, rarely and never with the exact meaning of these responses differing by question. The 'often' or 'sometimes' frequency responses to any one of the first six questions results in an automatic classification of a household into the overall 'severely food insecure category'; any 'never/sometimes' frequency of occurrence response to any of the next seven questions also results in the same category; and so on. The classification of 'food secure' can only result if the optimal response is given for questions 1–13, at least the optimal or second-best response for questions 14–19, and anything but the worst response for questions 20–24 (Maxwell et al., 2013).

The MFI indicator has threefold advantage over uni-dimensional stand-alone measures (Maxwell et al., 2013). First, the indicator is data-rich in that it captures multiple dimensions of food security. Second, it is very sensitive to food insecurity in that the indicator picks up both milder food insecurity manifestations as well as severe outcomes. Third, by taking an algorithmic approach, the multidimensional indicator avoids the pitfalls of arbitrary quantitative food security cut-offs along a raw score. Yet, the choice of cut-offs is ultimately subjective and hence it demands careful conceptual attention to each answer for overall food security classification (Maxwell et al., 2013). Each category currently labeled according to degrees of food security severity should be further described according to the types of conditions experienced by households classified into the category. This step would produce more-transparent results than those in non-reflective aggregated classification system.

5.4.2. Multidimensional Food Security Indicator Tabulation

Like HFIAS, the MFI is used to measure the severity and prevalence of household food security but unlike the former the latter does not give us continuous measure of the degree of food security in the household in the past four weeks. The MFI indicator helps us to calculate the condition, severity and prevalence of household food security. Food security conditions, severity and prevalence are used to report household food security status in the study. The food security condition indicator provides specific, disaggregated information about behaviors and perceptions of households on their food security status. The indicator presents the percentage of households that responded to each question in each category and hence it measures the percentage of households experiencing food security condition at differing levels of severity.

Table 11: Multidimensional food security indicator category scheme

MFI Category	<p>Calculate the Multidimensional Food Security category for each household.</p> <p>1 = Food Secure, 2= Mildly Food Insecure, 3 = Moderately Food Insecure, 4= Severely Food Insecure</p> <p>MFI Category = 1 If [(Q1 –Q6 =Never) or (Q7-Q8=Often) or (Q9-Q13=Never) or (Q14-Q18=Never/Rarely), or (Q19= Food Secure/Mildly Food Insecure) or (Q20-Q24= Often/Sometimes/Rare)</p> <p>MFI Category = 2 If [(Q7–Q8=Sometimes) or (Q9-Q13=Rarely) or (Q14 – Q18=Sometimes), or (Q19=Mildly Food Insecure), or (Q20-Q24=Never)</p> <p>MFI Category = 3 If [(Q1-Q6=Rarely) or (Q7-Q8=Rarely) or (Q9-Q13=Sometimes) or (Q14-Q18=Often), or (Q19=Severely Food Insecure)</p> <p>MFI Category = 4 If [(Q1-Q6=Often/Sometimes), or (Q7 – Q8= Never) or (Q9-Q18=Often), or (Q19=Severely Food Insecure)]</p>
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Source: Maxwell et al (2013)

The MFI Category indicator categorizes households into four levels of household food security status: severely, moderately and mildly food insecure, and food secure. Food secure households experience favorable conditions for the first thirteen questions or the second best conditions for questions 14 through 19, and should not experience the worst conditions for the high value foods. Likewise, a mildly food insecure household experiences none of the first six extreme food insecurity conditions and worries what to eat rarely. Yet, a mildly food insecure households may never eat high value food items like milk, meat, eggs, fruits and vegetables in the reference period. On the other hand, severely food insecure households experience the first six extreme food insecurity conditions. Likewise, moderately food insecure households experience extreme food insecurity conditions rarely. To calculate the MFI category variable, the researcher first assigned a code for the food security categories. The four food security categories were then created sequentially to ensure that households are classified according to their most severe response.

5.4.3. Multidimensional Household Food Security Status

The study has computed and reported the multidimensional food security status of households using descriptive statistics of prevalence and percentage. MFI prevalence was calculated to report multidimensional food security status of the households. The MFI prevalence refers to the percentage of households that fall in each food security category. That means:

$$\text{MFI Prevalence} = \frac{\text{Number of households in one MFI category}}{\text{Total number of households in all MFI categories}} \times 100$$

E.g. the percentage of severely food insecure households for instance can be calculated as:

$$\frac{\text{Number of households with MFI category 4}}{\text{Total number of households in all MFI categories}} \times 100$$

MFI Questionnaire: The MFI questionnaire constitutes twenty four questions (or indicators) each captures different food security [insecurity] constructs (see appendix I).

The responses (frequency) to the twenty-four multidimensional food insecurity indicator questions [variables] were scored and recoded as following:

Recode Response to MFI Questions (Q1 – Q24) as follows:

- Often = 1 Please recode to `1`
- Sometimes = 2 Please recode to `2`
- Rarely = 3 Please recode to `3`
- Never = 4 Please recode to `4`

We have then derived four categories of multidimensional food security categories of households: food secure, mildly food insecure, moderately food insecure and severely food insecure.

Definition of Food Secure Households (MFI Category 1): The MFI indicator defines food secure households as those who experience favorable conditions for the first thirteen questions or the second best condition for questions 14 through 19 but should not experience the worst condition for the high value foods. Food secure households should meet two important but contradicting food consumption requirements. On one hand, any member of a household should not experience the severe food insecurity indicators of hunger and starvation including going a whole day without eating, going to bed hungry, absence of food at home, skipping entire days without eating, begging, going elsewhere to eat. They should also consume neither seed stock stored for the next season nor gather wild foods; they should neither borrow food nor purchase it on credit. Conversely, food secure households should never experience the worst condition for the high value foods; i.e. they should at least consume milk and milk products, meat, eggs, fruits and vegetables rarely/sometimes, if not regularly. The study indeed computed the first (multidimensional food secure) category of households using the following

statistical command and found out that none of the sampled households were multi-dimensionally food secure in the survey time.

```
MFICategory1=IF(AND(Q1=4,Q2=4,Q3=4,Q4=4,Q5=4,Q6=4,Q7=1,Q8=1,Q9=4,Q10=4,Q11=4,Q12=4,Q13=4,Q14>2,Q15>2,Q16>2,Q17>2,Q18>2,Q19>1,Q20<4,Q21<4,Q22<4,Q23<4,Q24<4),"1")
```

This finding of quantitative data analysis confirmed us that there existed high multidimensional food insecurity prevalence in the area. The results of qualitative data analysis gathered via focus group discussion also substantiated the finding of the quantitative data analysis. The participants of the discussion unanimously revealed that in a year “Our agricultural production covers two to six months of our food needs”. Perhaps, a majority of the rural households in the area heavily depends on food aid and food-for-work for their survival. A female farmer participant of the discussion expresses the food insecurity situation in the area as “We live on food aid”. The aid is in the form of wheat donated, usually, by the USA.

Definition of Mildly Food Insecure Households (MFI Category 2): The MFI indicator defines mildly food insecure households as those households who experience none of the first six extreme food insecurity conditions, but do worry what to eat on rare occasions. They sometimes consume a monotonous diet that is considered undesirable; e.g. gather wild foods and immature crops; borrow food items from relatives or purchase food on a credit basis. They also eat some varieties of less acceptable food items and reduce the number and size of the meals eaten per day. Mildly food insecure households may never consume high value food items such as milk and milk products, meat, eggs, fruits and vegetables. We have thus calculated the second multidimensional food security (Mildly Food Insecure) category of households using the following statistical command and found out that almost all (98.75 percent) of the studied households were mildly food insecure a month prior to the survey.

This descriptive statistics reveals that the prevalence of mildly food insecurity is very high where almost all of the farm households in the area experience mild food insecurity. That is a small deviation in reduced agricultural production and reduction in the long-term productive safety-net program (for-for-work and free-food-aid version) could push a significant percentage of households into moderate or severe food insecurity condition. This high prevalence of mild food insecurity further reveals that many households in the area consume more monotonous diet than considered desirable; borrow food items from relatives or purchase it on credit basis. They also eat some varieties of less acceptable food items. The analysis further tells us almost all

households in the area might rarely have consumed high value food items such as milk and milk products, meat, eggs, fruits and vegetables. This high prevalence of mild food insecurity demonstrates that the population of the study has very homogeneous socioeconomic status. The following statistical command captures households who fall under the mildly food insecure category.

$$\text{MFICategory2}=\text{IF}(\text{OR}(\text{Q7}=2,\text{Q8}=2,\text{Q9}=3,\text{Q10}=3,\text{Q11}=3,\text{Q12}=3,\text{Q13}=3,\text{Q14}=2,\text{Q15}=2,\text{Q16}=2,\text{Q17}=2,\text{Q18}=2,\text{Q19}=3,\text{Q20}=4,\text{Q21}=4,\text{Q22}=4,\text{Q23}=4,\text{Q24}=4),\text{"2"}))$$

The qualitative data analysis reveals similar story about food insecurity condition in the area. The focus group discussants mentioned that “We usually eat monotonous diet. We eat similar food items day in and day out. However, thank to our government, we do not sleep hungry; we have at least food aid; almost all of us are members of at least one version of the productive safety-net program”. The participants of the discussion added that “PSNP program is our insurance; whenever our farm production fails; the government provides us food aid”.

Definition of Moderately Food Insecure (MFI Category 3): The MFI indicator defines moderately food insecure households as those households who experience the extreme food insecurity indicators of hunger and starvation rarely. They occasionally consume less desirable foodstuffs. Moderately food insecure households may gather wild foods and immature crops; borrow food from relatives or purchase it on credit basis. Food rationing strategies like cutting the number and size of meals is a distinctive feature of moderately food insecure households. They often consume limited variety of food items compromising their food preference. They often worry about the shortfall of food to eat. Conversely, moderately food insecure households never eat high value food items.

The study computed the third MFI (moderately food insecure) category of households using the following statistical command and found out that only 1.25 percent of households were moderately food insecure in the survey time. The prevalence of moderate food insecurity was very low. The disaggregated individual multidimensional food security indicator analysis also confirmed that majority of the households experienced the distinctive feature of moderate food insecurity.

$$\text{MFICategory3}=\text{IF}(\text{OR}(\text{Q1}=3,\text{Q2}=3,\text{Q3}=3,\text{Q4}=3,\text{Q5}=3,\text{Q6}=3,\text{Q7}=3,\text{Q8}=3,\text{Q9}=2,\text{Q10}=2,\text{Q11}=2,\text{Q12}=2,\text{Q13}=2,\text{Q14}=1,\text{Q15}=1,\text{Q16}=1,\text{Q17}=1,\text{Q18}=1,\text{Q19}=4),\text{"3"}))$$

Definition of Severely Food Insecure (MFI Category 4): The MFI indicator defines severely food insecure households as those households who experience the six most severe food insecurity conditions of running without eating for at least one whole day and night, absence of food at home, begging, and/or eating elsewhere. They usually consume a monotonous diet made up solely of grain and pulses. They heavily depend on food aid and loans (government aid and food loans from relatives) and/or purchased on credit. Furthermore, the severely food insecure households consume neither food items they prefer nor high value foodstuffs. The researcher thus computed the fourth MFI (Severely Food Insecure) category of households using the following statistical command and found out that none of the studied households were severely food insecure in the four weeks prior to the survey. That means there was zero severe food insecurity prevalence in the study area.

$$\text{MFI}4 = \text{IF}(\text{OR}(\text{Q1}<3, \text{Q2}<3, \text{Q3}<3, \text{Q4}<3, \text{Q5}<3, \text{Q6}<3, \text{Q7}=4, \text{Q8}=4, \text{Q9}=1, \text{Q10}=1, \text{Q11}=1, \text{Q12}=1, \text{Q13}=1), "4")$$

The qualitative data gathered through focus group discussion also substantiated the finding of the quantitative data. The focus group discussants unanimously revealed that the “Dark Age of Misery and Starvation” has gone. The focus group claimed that households in the area never experienced the extreme food insecurity indicators in the four weeks prior to the survey. Likewise, households in the area might never consume the high value food items of milk and milk products, meat, eggs, fruits and vegetables. The following statistical command captures households who fall under the severe food insecure category

Table 12: Multidimensional food security status of households

S/No.	MFI categories	Frequency	Percentage
1	Food Secure	-----	-----
2	Mildly Food Insecure	395	98.75
3	Moderately Food Insecure	5	1.25
4	Severely Food Insecure	-----	-----
	Total	400	100.00

Source: Household survey, 2018

5.4.4. Multidimensional Food Security Decomposition

Table 13: Multidimensional food security indicators decomposition

Multidimensional food security indicators			Possible Response Options								
Indicator	Code	Indicator Questions (30 days recall period)	Often		Sometimes		Rarely		Never		
			N	%	N	%	N	%	N	%	
1	HFIAS/HHS	NOEAT	How often did you or any HH member have to go a whole day without eating?	1	0.25	8	2.00	39	9.75	352	88.00
2	HFIAS/HHS	SLPHUN	How often did you or any HH member go to sleep at night hungry?	1	0.25	13	3.25	139	34.75	247	61.75
3	HFIAS/HHS	NOFOOD	How often was there ever no food in your HH?	2	0.50	3	0.75	21	5.25	374	93.50
4	CSI	SKIPEAT	How often has the HH had to skip entire days without eating?	1	0.25	3	0.75	19	4.75	377	94.25
5	CSI	SENDEREG	How often has the HH had to send HH members to beg?	-----	-----	1	0.25	4	1.00	395	98.75
6	CSI	SENDEAT	How often has the HH had to send HH members to eat elsewhere?	-----	-----	1	0.25	103	25.75	296	74.00
7	FCS/HDDS	PULSE	How often has the HH eaten any pulses?	1	0.25	134	33.50	255	63.75	10	2.50
8	FCS/HDDS	GRAIN	How often has the HH eaten any food made from grain?	382	95.50	15	3.75	2	0.50	1	0.25
9	CSI	EATSEED	How often has the HH had to consume seed stock held for next season?	3	0.75	9	2.25	173	43.25	215	53.75
10	CSI	WILD	How often has the HH had to gather wild food, hunt, or harvest immature crops?	2	0.50	39	9.75	148	37.00	211	52.75
11	CSI	FDCRED	How often has the HH had to purchase food on credit?	3	0.75	25	6.25	173	43.25	199	49.75
12	CSI/rCSI	BORROW	How often has the HH had to borrow food, or rely on help from a relative?	1	0.25	22	5.50	160	40.00	217	54.25
13	HFIAS	NOTWNT	How often did you or any HH member have to eat foods you did not want to eat?	41	10.25	304	76.00	48	12.00	7	1.75
14	HFIAS	LIMVAR	How often did you or any HH member have to eat a limited variety of foods?	328	82.00	66	16.50	5	1.25	1	0.25
15	HFIAS	PREFER	How often were you/any HH member not able to eat the kinds of foods you preferred?	129	32.25	264	66.00	5	1.25	2	0.50
16	CSI/rCSI	FWRMEAL	How often has the HH had to reduce the number of meals eaten in a day?	1	0.25	8	2.00	78	19.50	313	78.25
17	CSI/rCSI	LMTPORT	How often has the HH had to limit portion size at meal times?	3	0.75	80	20.00	286	71.50	31	7.75
18	HFIAS	WORRY	How often did you worry that your HH would not have enough food?	13	3.25	114	28.50	228	57.00	45	11.25
19	SAFS	SAFS	Self-assessed food security during past 30 days	67*	16.75	139*	34.75	167*	41.75	27*	6.75
20	FCS/HDDS	DAIRY	How often has the HH eaten any dairy products?	12	3.00	102	25.50	188	47.00	98	24.50
21	FCS/HDDS	EGGS	How often has the HH eaten any eggs?	7	1.75	99	24.75	258	64.50	36	9.00
22	FCS/HDDS	MEAT	How often has the HH eaten any meat, fish?	1	0.25	37	9.25	260	65.00	102	25.50
23	FCS/HDDS	FRUIT	How often has the HH eaten any fruits?	5	1.25	36	9.00	114	28.50	245	61.25
24	FCS/HDDS	VEGET	How often has the HH eaten any vegetables?	132	33.00	169	42.25	85	21.25	14	3.50

* = Food Secure * = Mildly Food Insecure ♥ = Moderately Food Insecure ♦ = Severely Food Insecure

Source: Author's Computation

The aggregate multidimensional food security analysis (Table 12) shows that almost all the sampled households were mildly food insecure. It is, however, possible to disaggregate each of the indicators to further examine food security conditions that households experienced. The decomposition of multidimensional food security (Table 13) indicates that some households in the area experienced each indicator at all levels of severity. The disaggregated analysis of multidimensional food security indicates that majority of the households in the area never experienced the extreme food insecurity indicators of hunger and starvation including going a whole day without eating (88.00 percent), going to bed hungry (61.75 percent), absence of food at home (93.50 percent), skipping entire days without eating (94.25 percent), begging (98.75 percent), and sending members of the household to eat elsewhere (74 percent). Likewise, great majority of the households compromised the variety of food they consumed (82 percent), their sociocultural food preference (98.25 percent) and food items they needed (76 percent).

Furthermore, majority of the households rarely consumed high value food items of milk and milk products, meat, eggs, fruits and vegetables. On the other hand, great majority (95.5 percent) of the households consumed pulses and grain; never reduced the number (78.25 percent) and quantity (71.5 percent) of meals they ate on any day in the four weeks prior to the survey. They also rarely worried (57 percent) about the absence of sufficient quantity of food in their home.

The multidimensional food security indicator questionnaire has one important food security self-perception question. The ordinal food security self-perception question referred to the food security status of the households asked to respond on a scale of 1 to 4 where 1 referred to food secure, 2 referred to mildly food insecure, 3 referred to moderately food insecure, and 4 referred to severely food insecure. Indeed, great majority of the studied households perceived that they were food insecure (see Table 13). Only 16.75 percent of the studied households affirmatively perceived that they were food secure four weeks prior the survey.

MFI is relatively a new indicator under construction. Perhaps multidimensional food security categorization requires further investigation and refining. It is here imperative to support the finding of the multidimensional food security indicator with other longstanding food security indicators such as HFIAS. The following section thus presents the findings of food security status of households using HFIAS score.

5.5. Household Food Insecurity Access Scale (HFIAS)

HFIAS measures the adequacy and quality of food access as well as uncertainty and anxiety of households over insecure access to food (Coates et al., 2007). The Food and Nutrition Technical Assistance Project of the USAID developed HFIAS to measure food access experience of households (USAID, 1992). This HFIAS indicator is essentially constructed to measure the access dimension of food security. The HFIAS questionnaire consists of nine occurrence questions hierarchically increasing level of severity of food insecurity (food access); and nine follow up “frequency-of-occurrence” questions to each occurrence question to determine how often the condition occurred. The interviewer must skip the frequency-of-occurrence question unless the respondent reports that the household experienced the food insecurity condition described in the corresponding occurrence question in the previous four weeks (30 days) (Coates et al., 2007). The researcher first calculated the HFIAS score variable for each household by summing the codes for each frequency-of-occurrence question. Before summing the frequency-of-occurrence codes, the researcher coded the frequency-of-occurrence as 0 for all cases where the answer to the corresponding occurrence question was “No” (i.e., if Q1=0 then Q1a=0, if Q2 =0 then Q2a=0, and so on). HFIAS generates a single statistical score ranging from 0 to 27 to measure household food security status. The maximum score for a household is 27 where the household response to all nine frequency-of-occurrence questions was “often”, coded with response code of 3; the minimum score is 0 (where the household responded “No” to all occurrence questions where the interviewer skipped all frequency-of-occurrence questions and subsequently coded them as 0. The higher HFIAS score hence indicates the more food insecurity experience of the household. The lower score indicates the less food insecurity experience of the household.

This HFIAS score is used to identify food insecure households and target programs designed to escape the food insecure households. It captures feelings of uncertainty and anxiety over food, perceptions of insufficient quality and quantity of food, reductions of food intake and its consequences in the household and feelings of shame. In other words, the indicator captures household behaviors signifying insufficient quality and quantity, as well as anxiety over insecure access. The HFIAS generic questions represent universal domains of household food insecurity (access) experience and can be finally used to assign households along a continuum of severity from food secure to severely insecure. The rationale behind HFIAS is that

experiencing food insecurity causes predictable reactions that can be captured, quantified and presented on a severity scale (Coates et al., 2007).

The HFIAS score is a continuous measure of the degree of food access in the household in the past four weeks. We have calculated the HFIAS score variable. The highest HFIAS score was found to be 26 and the lowest was 0. The score indicates that only 30 (7.5 percent) of the studied farm households have scored 0 HFIAS; i.e. they experienced none of the nine HFIAS indicator questions. The study further calculated the average HFIAS score using
$$\text{Average HFIAS Score} = \frac{\text{(the Sum of HFIAS Scores in the sample)}}{\text{Number of HFIAS Scores (i.e. households) in the sample}}$$
. The average HFIAS score was found to be 12.83.

Table 14: Household Food Insecurity Access Scale Scheme (HFIAS)

Calculating Household Food Insecurity Access Category for each household 1 = Food Secure, 2= Mildly Food Insecure Access, 3 = Moderately Food Insecure Access, 4= Severely Food Insecure Access	
HFIAS Category	<p>HFIAS Category = 1 If [(Q1a=0 or Q1a=1) and Q2=0 and Q3=0 and Q4=0 and Q5=0 and Q6=0 and Q7=0 and Q8=0 and Q9=0]</p> <p>HFIAS Category = 2 If [(Q1a=2 or Q1a=3 or Q2a=1 or Q2a=2 or Q2a=3 or Q3a=1 or Q4a=1) and Q5=0 and Q6=0 and Q7=0 and Q8=0 and Q9=0]</p> <p>HFIAS Category = 3 If [(Q3a=2 or Q3a=3 or Q4a=2 or Q4a=3 or Q5a=1 or Q5a=2 or Q6a=1 or Q6a=2) and Q7=0 and Q8=0 and Q9=0]</p> <p>HFIAS Category = 4 If [Q5a=3 or Q6a=3 or Q7a=1 or Q7a=2 or Q7a=3 or Q8a=1 or Q8a=2 or Q8a=3 or Q9a=1 or Q9a=2 or Q9a=3]</p>

Source: Coates, Swindale and Bilinsky (2007)

We have also calculated the Household Food Insecurity Access prevalence (HFIAP) status indicator. This HFIAP is a categorical household food insecurity status indicator. It divides households into severely, moderately and mildly food insecure and food secure categories (Coates et al., 2007). First, the researcher calculated the HFIAS category variable for each household by assigning a code for the food insecurity (access) category in which it falls. He then coded the frequency-of-occurrence as 0 for all cases where the answer to the corresponding occurrence question was no (i.e., if Q1=0 then Q1a=0, if Q2 =0 then Q2a=0, and so on) prior to assigning the food insecurity (access) category codes. The four food security categories have been created sequentially in the same order as shown below to ensure that households are classified according to their most severe response.

After categorizing households into four levels of household food security status, the prevalence of different levels of household food insecurity (access) is calculated. This HFIA prevalence refers to the percentage of households that fall in each food security category. That means:

$$\text{HFIA Prevalence} = \frac{\text{Number of households in one HFIA category 1}}{\text{Total number of households with any HFIA category}} \times 100$$

The percentage of severely food insecure households for instance can be calculated as:

$$\frac{\text{Number of households with HFIA category 4}}{\text{Total number of households with any HFIA category}} \times 100$$

The HFIAS Questionnaire: The responses (frequency) to the nine (Q1 – Q9) generic HFIAS questions [variables] were scored and recoded as following:

Never	= 1	Please recode to `0`
Rarely	= 2	Please recode to `1`
Sometimes	= 3	Please recode to `2`
Often	= 4	Please recode to `3`

We have then derived four HFIAS categories of households: food secure, mildly food insecure, moderately food insecure and severely food insecure.

A. Definition of Food Secure Households (HFIAS Category 1): HFIAS indicator defines food secure households as those households who experience none of the food insecurity (access) conditions or just “experiences worry” rarely. We computed the first HFIAS (Food Secure) category of households using the following statistical command and found out that 32 (7.75 percent) of the sampled households were food secure in the four weeks prior to the survey.

$$\text{HFIASCategory1} = \text{IF}(\text{AND}(\text{B2} < 2, \text{C2} = 0, \text{E2} = 0, \text{G2} = 0, \text{I2} = 0, \text{K2} = 0, \text{M2} = 0, \text{O2} = 0, \text{Q2} = 0))$$

Definition of Mildly Food Insecure Households (HFIAS Category 2): HFIAS indicator defines mildly food insecure households as those who worry about not having enough food sometimes/often, and/or is unable to consume food items it preferred; and/or the household eats a more monotonous and undesired diet rarely. It does not, however, cut back on quantity nor experience any of the three most severe conditions (running out of food, going to bed hungry, or going a whole day and night without eating). We have thus calculated the second HFIAS (Mildly Food Insecure) category of households using the following statistical command and found out that 55 (13.75 percent) of the studied households were mildly food insecure in the four weeks prior the survey time (see Table 15).

$$\text{HFIASCategory2} = \text{IF}(\text{OR}(\text{B2} = 2, \text{B2} = 3, \text{D2} > 0, \text{F2} = 1, \text{H2} = 1), \text{IF}(\text{AND}(\text{I2} = 0, \text{K2} = 0, \text{M2} = 0, \text{O2} = 0, \text{Q2} = 0))$$

B. Definition of Moderately Food Insecure (HFIAS Category 3): Moderately food insecure households scarify quality of food more frequently. They regularly consume a monotonous diet; and/or have started to cut back on quantity of food they should have to eat by reducing the size and/or number of meals rarely/sometimes. They do not, however, experience any of the three most severe food insecurity conditions. The researcher computed the third HFIAS (Moderately Food Insecure) category of households using the following statistical command and found out that 192 (48.00 percent) numbers of households were moderately food insecure in the four weeks prior to the survey.

$$\text{HFIASCategory3} = \text{IF}(\text{OR}(\text{F2}>1, \text{H2}>1, \text{J2}=1, \text{J2}=2, \text{L2}=1, \text{L2}=2), \text{IF}(\text{AND}(\text{M2}=0, \text{O2}=0, \text{Q2}=0))$$

C. Definition of Severely Food Insecure (HFIAS Category 4): Severely food insecure households regularly scarify the quantity of food they should have to consume through cutting back the size and number of meals. They also experience any of the three most severe food insecurity conditions (running out of food, going to bed hungry, and going a whole day and night without eating) rarely. In other words, any household who experiences one of the three most severe food insecurity conditions even once is considered as severely food insecure. The researcher lastly computed the fourth HFIAS (Severely Food Insecure) category of households using the following statistical command and found out that 122 (30.50 percent) of the studied households were severely food insecure in the survey reference period.

$$\text{HFIAS Category4} = \text{IF}(\text{OR}(\text{J2}=3, \text{L2}=3, \text{N2}>0, \text{P2}>0, \text{R2}>0))$$

Table 15: Household Food Insecurity Access Scale (HFIAS) Score

S/No.	HFIAS Categories	Frequency	Percentage
1	Food Secure	31	7.75
2	Mildly Food Insecure	55	13.75
3	Moderately Food Insecure	192	48.00
4	Severely Food Insecure	122	30.50
	Total	400	100.00

Source: Author's computation, 2018

5.6. Multidimensional Food Security and HFIAS Comparative Analysis

The researcher measured food security status of households using HFIAS Score to substantiate the finding of the multidimensional food security indicator. The multidimensional food security categorization requires further investigation and refining. It is therefore imperative to compare the finding of the multidimensional food security indicator with other longstanding food security indicators such as HFIAS. On the other hand, multidimensional food security indicator does not provide a quantitative continuous score without it we cannot carry out correlation analysis with other important outcome variables. Table 5.6 compares and contrasts the findings of MFI and HFIAS.

Table 16: Multidimensional food security and HFIAS comparative analysis

Food Security Indicator	Food Secure		Mildly Food Insecure		Moderately Food Insecure		Severely Food Insecure	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
MFI Score	-----	-----	395	98.75	5	1.25	-----	-----
HFIAS Score	31	7.75	55	13.75	192	48.00	122	30.50

Source: Author computation, 2018

The comprehensive multidimensional food security metrics reveals that majority (98.75 percent) of the studied households were mildly food insecure. That means there is neither food security nor severe food insecurity in the study area. That is none of the sampled households experienced the six most severe food insecurity indicators of hunger and starvation (going a whole day without eating, going to bed hungry, absence of food at home, skipping entire days without eating, begging, and going elsewhere to eat). They also consumed neither seed stock stored for the next season nor gathered wild foods; they neither borrowed food nor purchase it on credit bases. Paradoxically, there were no households who regularly consume high value food items of milk and milk products, meat, eggs, fruits and vegetables. On the other hand, the HFIAS score categorized the households into food secure (7.75 percent), mildly food insecure (13.75 percent), moderately food insecure (48 percent) and severely food insecure (30.5 percent). This HFIAS score indicates that there are few food secure households in the area. Put it differently, the HFIAS score tells us there is high prevalence of severe food insecurity condition in the area. The difference of the finding between the MFI and HFIAS basically emanates from the theoretical and methodological construction difference between the indicators.

5.7. Chapter Summary

The study estimated food security status of households using multidimensional food security indicator. The indicator captures all dimensions of food security to measure it in totality. It categorizes households into food secure, mildly food insecure, moderately food insecure and severely food insecure. The indicator emphasizes that food secure households should not experience the severe food insecurity indicators of hunger and starvation. They should also consume neither seed stock stored for the next season nor gather wild foods; they should neither borrow food nor purchase it on credit. Contrary, food secure households should never experience the worst condition for the high value foods. None of the sampled households were multi-dimensionally food secure in the survey time. Second, the indicator defines mildly food insecure households as those households who experience none of the first six extreme food insecurity conditions. They sometimes consume a monotonous diet that is considered undesirable. They also reduce the number and size of the meals eaten per day. In contrast, mildly food insecure households may never consume high value food items. Almost all of the studied households were mildly food insecure a month prior to the survey.

Third, MFI defines moderately food insecure households as those households who experience the extreme food insecurity indicators of hunger and starvation rarely. They occasionally consume less desirable foodstuffs. They may also gather wild foods and immature crops; borrow food from relatives or purchase it on credit basis. Only 1.25 percent of the surveyed households were moderately food insecure in the survey time. Lastly, MFI defines severely food insecure households as those households who experience the six most severe food insecurity conditions. They usually consume a monotonous diet made up solely of grain and pulses. They heavily depend on food aid and loans. They also consume neither food items they prefer nor high value foodstuffs. In fact, the prevalence of severe food insecurity was zero in the study area.

6. RESILIENCE OF HOUSEHOLDS TO FOOD INSECURITY

6.1. Introduction

There is no universally agreed methodology to operationalize and measure resilience empirically (Martin and Sunley, 2015). Yet, every approach, tool and method used to measure resilience emanates from and builds upon the operational definition of the term (FAO, 2016). It is indeed compulsory to define or adopt a clear definition of resilience in food security perspectives without it cannot be quantified clearly. Resilience intends to measure the capacity of households to absorb the adverse effects of unpredictable shocks and stresses instead of predicting the occurrence of such crises. Resilience means the ability of an individual/household/community/system to prepare for, withstand to, and recover from shocks and stresses (Smith et al., 2015; Smith and Frankenberger, 2015). It intrinsically constitutes the capacity of a system/community/household to absorb, adapt and transform in the face of shocks and stress crises (Constas et al., 2014a). The shocks may be endogenous, intrinsically related to household capital, or exogenous which are externally related to household capitals. The households have no control over the exogenous shocks; they rather react to such external shocks through absorptive and adaptive capacities [resources] available at their hand. Resilience provides a unified response to the persistent array of shocks and stresses that threatens the wellbeing of households (Constas et al., 2014b).

Resilience of households to food insecurity here refers to the ability of those households to maintain certain level of food security to withstand shocks and stresses (Alinovi, Mane and Romano, 2009 and 210). This resilience of households to food insecurity at a given point in time depends primarily on the (livelihood) options available to them to make a living and on their ability to handle risks (Alinovi, et al., 2010). Resilient households can easily reduce their exposure to, cope with and adapt to natural and manmade shocks and stresses than their less resilient counterparts. It constitutes ex-ante actions aimed at reducing or mitigating risks, and ex-post actions to cope with those risks. It also covers both short-term actions (coping strategies) and long term actions (adaptation strategies) (Alinovi, Mane and Romano, 2009).

6.2. Resilience Capacity Indicators

Resilience measurement can be carried out at two different points in time (Constas et al., 2014b). It can be measured to produce a set of ex-post (current) and ex-ante (future) indicators

aimed at examining the wellbeing change over time of a reference group and predicting the prospective wellbeing of that target group, respectively. In other words, there are two, one direct and the other indirect measures of resilience. The direct (or descriptive) measure of resilience aims at targeting and ranking households. It intends to identify resilient and less resilient households. This direct measure of resilience looks at the capacity and structure at a specific moment in time. The indirect (or inferential) measure of resilience looks at its determinants. The indirect measure allows statistical inference to be made that ultimately translates into clear and sound policy indications and can be adopted for predicting a dynamic perspective of resilience (FAO, 2016). This study follows the direct (descriptive) approach to measure resilience. Conostas et al. (2014b) noted that both ex-post and ex-ante indicators are needed to model resilience. Nonetheless, resilience can be measured based on the context, available data and objectives of the study being undertaken (Schipper and Langston, 2015). Moreover, resilience studies are often undertaken in areas where there exist natural and manmade crises such as recurrent drought, epidemics, protracted civil wars and conflicts; pervasive poverty and food insecurity. Ahferom Wereda is a typical research site for such studies because great majority of the population lives under abject poverty and food insecurity. It has also been experiencing countless natural and manmade shocks and stresses.

Resilience is measured using proxy indicators (FAO, 2016). It is a latent variable made up of multiple indicators (or components) (see Alinovi et al., 2009 and 2010; Ciani and Romano, 2013; Maxwell et al., 2013; Smith et al., 2014; Conostas et al., 2014b). Each component is also a latent variable because it cannot be observed directly (Conostas et al., 2014b). Every component is estimated separately, to generate a composite index of household resilience. In the current study, indicators are concepts that explain part of “the semantic space...of the higher abstraction” of resilience (INDRIX by Universita di Roma, 2015). Béné et al (2012) propose that absorptive, adaptive, and transformative capacities are the three core elements of an analytical framework for resilience analysis. The review of empirical studies demonstrates that resilience has such multiple components and indicators as livelihood resources, public services, social safety-nets, economic resources (financial resources and market), human capital (education/skills/abilities and health), agricultural technology innovations and uses, natural resources, infrastructure, livelihood stability and adaptive capacity, and institutional resources and capabilities (see Conostas et al., 2014b; Alinovi et al., 2009; Alinovi et al., 2010; Ciani and Romano, 2013; Maxwell et al., 2013; and Smith et al., 2014). However, the components used to

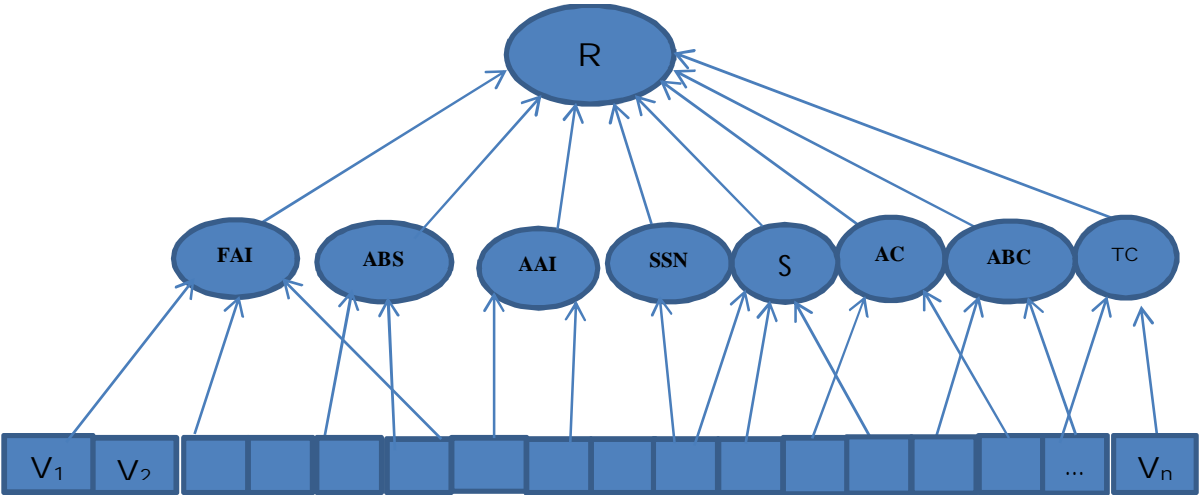
measure resilience can vary from context to context (Constas et al., 2014b). Selection of relevant outcome and explanatory variables used to measure resilience of a household in a given locality hence depends on the theoretical literature and prior knowledge of the researcher. The researcher exhaustively reviewed the empirical literature and adopts the resilience model (Alinovi et al, 2010) in equation (6.1) to estimate resilience capacity of households to food insecurity in the study area. However, the resilience capacity indicators are not mutually exclusive (IGAD, 2015) which makes the categorization of certain indicators challenging.

$$R_i = f(wIFAI_i, wABSi, wAAi, wSSNi, wSi, wACi, wABCi, wTCi) \dots \dots \dots (6.1)$$

Where: R = Resilience, FAI = Food Access Index, ABS= Access to Basic Services, AA = Agricultural Assets, SSN= Social Safety Nets, S =Stability, AC = Adaptive Capacity, ABC= Absorptive Capacity, and TC = Transformative Capacity; w = the weight for the Kth latent variable in defining resilience of the ith household.

Resilience is not observable per se, and is considered as a latent variable depending on the terms on the right hand side of the equation (6.1). This study adopts a hierarchical resilience model where some of the variables are dependent on one side and independent from the other. In order to estimate the resilience of a household (R) to food insecurity, the study first estimated the latent variables on the right side of the model separately. Figure (5) shows the path diagram to model household resilience to food insecurity. In the causal models literature, the circles represent the latent variables while the boxes represent observed variables (Alinovi et al., 2009).

Figure 5: Path diagram resilience model of households to food insecurity



Source: Alinovi, Mane and Romano (2009)

6.3. Weighting Method

The resilience composite index is made up of different latent and observable variables measured in different ways using different units and scales. The study first identified such latent resilience dimensions as income and food access, basic services access, agricultural asset, social asset, livelihood stability, adaptive capacity, absorptive capacity, and transformative capacity to estimate the resilience of households to undesirable livelihood outcome. Each latent dimension constitutes a number of observable variables different from the other and is measured separately using different statistical tools. The variable selection procedures in each latent outcome variables is usually complex in the resilience framework where multidimensional correlation often make a single observable variables relevant to several latent variables.

The importance and contributions of the indicators to resilience capacity of households are unequal. It is hence compulsory to attach weights to each resilience indicators and variables. There are various weight determination methods and techniques in the literature (see chapter 4). This study here employed multivariate (PCA) technique to reduce the number of variables and estimate the contribution (weight) of each variable to the resilience index. PCA is a multivariate data analysis technique used to reduce the dimension and number of several interrelated variables into a new ordered set of few uncorrelated variables which retain most of the variations in all of the original variables (Jolliffe, 2002). The first principal component captures the largest possible variance (information) and explains the largest part of the dataset; and the second component follows the first component, and so on. PCA is also a data-driven (or frequency-based) weighting determination method (Perez-Mayo, 2005). It is further used to construct the structural relationships between key variables of interest of the study population.

This study adopted multi-stage (stepwise) modeling to estimate resilience of households to food insecurity. In the first stage, the study run PCA for the latent indicators of food access, basic services, agricultural asset, social asset, stability, adaptive capacity, absorptive capacity, and transformative capacity separately to reduce the number of variables and attach weights to each variable used to measure these latent indicators. The multidimensionality of the concept of resilience could also lead us to double counting of variables where a single variable might have been relevant to estimate more than one latent variable in the model. It is first imperative to check the measurement scale, [normality] distribution of variables, and sampling adequacy to carryon PCA analysis. Evidently, any principal factor analysis begins with correlation matrix in

which the correlations between the study variables are inspected to avoid any redundancy. The variables should not be highly correlated (Field 2000). Actually, the researcher first checked the correlation between the variables where two variables whose correlation coefficient above 0.9 were either combined into one or deleted one of them from the analysis. This is because identical variables whose correlation coefficient above 0.9 captures similar concepts of the index of interest. The study also deleted any variables whose correlation coefficient is below 0.1. That means one or more of the variables might load only onto one principal component making its own principal component. Such variable does not have explanatory power to the construct the researcher is interested in nor does it help him to reduce the number of items.

PCA is essentially designed to analyze a set of quantitative variables measured in the same units (Booyesen, Berg and Burger, 2008). It is also used to analyze normally-distributed continuous variables (Field, 2000; and Asselin and Anh, 2008). It further requires linear constraints that assume the distance between the categories are the same and the categories are ordered (Booyesen, Berg and Burger, 2008). The dataset of the study, however, constitutes different variables measured in different ways using different measurement scales. It is therefore imperative to first normalize each variable using its mean and standard deviation so as to bring the values of the variables to a comparable range. That is;

$$\text{Normalized value} = \frac{\text{Observed value} - \text{Mean value}}{\text{Standard Deviation}} \dots\dots\dots (6.2)$$

For example, $X_{1j} = \frac{X_{1j} - \bar{X}_{1j}}{S_{1j}}$ where X_{1j} is the observed value of variable X_{1j} , \bar{X}_{1j} equals to the mean value of X_{1j} , and S_{1j} is its standard deviation. Suppose now we have a set of p variables X_1, X_2, \dots, X_p representing p attributes of N households. The selected variables are expressed as linear combinations of a set of underlying components for each household j :

$$\begin{aligned} Z_{1j} &= \alpha_{11}X_{1j} + \alpha_{12}X_{2j} + \alpha_{13}X_{3j} + \dots + \alpha_{1p}X_{pj} \\ Z_{2j} &= \alpha_{21}X_{1j} + \alpha_{22}X_{2j} + \alpha_{23}X_{3j} + \dots + \alpha_{2p}X_{pj} \\ &\vdots \\ Z_p &= \alpha_{p1}X_{1j} + \alpha_{p2}X_{2j} + \alpha_{p3}X_{3j} + \dots + \alpha_{pp}X_{pj} \end{aligned} \dots\dots\dots (6.3)$$

where the Z 's are the components and α 's are the coefficients on each component for each variable. This system of equations can be expressed as $Z = \mathbf{R}X$ where $Z = (Z_1, \dots, Z_p)$, $X = (X_1, \dots, X_p)$ and \mathbf{R} is the matrix of coefficients. However, only the left side of each line is observed, and hence the solution of the equation is indeterminate. PCA solves the indeterminacy of the

equation by finding the linear combination of the variables with maximum variance (usually the first principal component X_{1j}), then finding a second linear combination of the variables orthogonal to the first and with maximal remaining variance, and so on. The coefficient of the first principal component, $\alpha_{11} \dots \alpha_{1p}$, is the maximum variance of Z_1 subjects to the constraint that $\alpha_{11}^2 + \dots + \alpha_{1p}^2 = 1$. The variance of the first component is equal to λ_1 , the largest eigenvalue of \mathbf{R} . The second principal component is completely uncorrelated with the first component and has variance equal to λ_2 , the second largest eigenvalue of \mathbf{R} , and so on. Technically, PCA procedure solves the equations $(\mathbf{R} - \lambda\mathbf{I})\mathbf{v}n = 0$ for λ_n and $\mathbf{v}n$, where \mathbf{R} is the matrix of correlations between the scaled variables (the Z 's) and $\mathbf{v}n$ is the vector of coefficients on the n th component for each variable. Mathematical computation of the above equation provides the characteristic roots of \mathbf{R} , λ_n (also known as eigenvalues), and their associated eigenvectors, $\mathbf{v}n$. The final set of estimates is produced by scaling the $\mathbf{v}ns$ so that the sum of their squares sums to the total variance—another restriction imposed to achieve determinacy of the problem. The scoring factors from the model are recovered by inverting the system implied by the above equation (6.3). This yields a set of estimates for each of the Z -principal components:

$$\begin{aligned} X_{1j} &= \beta_{11}Z_{1j} + \beta_{12}Z_{2j} + \dots + \\ X_{zj} &= \beta_{z1}Z_{1j} + \beta_{z2}Z_{2j} + \dots + \beta_{zz}Z_{zj} \dots \dots \dots \end{aligned} \quad (6.4)$$

Where β of the principal component matrix refers to the factor loadings of the variables. If we substitute Zs by $\frac{X_{1j} - \bar{X}_{1j}}{S_{1j}}$ to normalize the value of each variable, we then get the following equation (6.5) to calculate the resilience indices.

$$X_{1j} = \beta_{11} \left(\frac{X_{1j} - \bar{X}_{1j}}{S_{1j}} \right) + \dots + \beta_{1z} \left(\frac{X_{zj} - \bar{X}_z}{S_z} \right) \dots \dots \dots \quad (6.5)$$

The study has then checked the adequacy of the sample size using Kaiser-Meyer-Olkin (KMO). KMO measures sampling adequacy. It indicates the degree to which each variable in a set is predicted without error by the other variables. KMO value of 0 indicates that the sum of partial correlations is large relative to the sum correlations, indicating principal analysis is likely to be inappropriate. A KMO value close to 1 indicates that the sum of partial correlations is not large relative to the sum of correlations and so principal analysis should yield distinct and reliable components. Field (2000) advised us to accept KMO values greater than 0.5.

The study next applied PCA to reduce the number of variables used to construct resilience indices. The new principal components are a linear combination of optimally-weighted

observed (original) variables. Each component accounts for a maximal amount of variance in the observed variables that was not accounted for by the preceding components, and is uncorrelated with all of the preceding components, and the squares of its coefficients sum to one. The PCA depends upon the Eigen-decomposition of positive semi-definite matrices and upon the singular value decomposition of rectangular matrices (Abdi and Williams, 2010). It involves finding the eigenvalues and eigenvectors of the correlation matrix. The eigenvalues here indicate the amount of variance accounted for by each of the components/variables. The new (artificial) components display varying degrees of correlation with the observed variables but are completely uncorrelated with one another. The study actually retained principal components whose Eigen value is above 1 (Guttman-Kaiser rule). The rationale behind retaining components whose Eigen value above 1 is that each variable contributes one unit of variance to the total variance in the dataset. That means any component displaying an Eigen value greater than 1 is accounting for greater amount of variance than had to contribute. The study then checked the communalities right after the principal factors is extracted. The communality of a variable represents the proportion of the variance in that variable that can be accounted for by all extracted factors. High communality of a variable indicates that the extracted factors account for a big proportion of variance of that variable.

Factor loadings show the correlation between the principal factors and the original variables (Rietveld and Van Hout 1993); and weights each variable contributes to the construct under scrutiny. The largest factors loaded on each variable were used as a weight for that variable. The weights attached for each variables and indicators varies between -1 and +1 where the sign of the loading factors (weights) denoting the direction of the relationship of the indicator (variable) with other indicators and variables used to construct the respective index. The magnitude of the loading factors (weights) indicates the contribution of each indicator (variable) to the value of the index (Field, 2000). In other words, the loading factors (weights) measure the relative importance of each indicator (variable) in the resilience dimension. Of course, the study first rotated the original correlation matrix using orthogonal rotation to dissociate the variables and alter the pattern of the factor loadings for better interpretation. The study finally calculated the indices of each resilience dimension using equation 6.5. The index scores of agricultural asset, social asset, stability, adaptive capacity, absorptive capacity, and transformative capacity describes the relative contribution of each resilience dimension (indicator) to the overall resilience index.

In the same vein, the study here in the second stage run PCA for all of the observable variables altogether to generate loading factors (weights) used to calculate the overall resilience index. The overall resilience capacity index was then computed by multiplying the normalized values of the variables and the factor loadings (weights) generated in and assigned to each variable in the second stage using the following formula.

$$Resilience\ Index = \sum_{i=1}^K \beta_i \left(\frac{X_{ij} - \bar{X}_i}{S_i} \right) \dots \dots \dots (6.6)$$

The study lastly decomposed the index precisely agro-ecology and sex wise to understand the whole resilience capacity of households to food insecurity.

6.4. Shock Exposure

Resilience essentially refers to the ability of social system/unit/individual/households/communities to prepare for, withstand, and recover from shocks and stresses. It is therefore imperative to measure the exposure of households to shocks and stresses in order to understand and quantify resilience explicitly. The use of [vague] synonymous words (such as disaster, risk, shock, hazard and vulnerability) with different meanings by research and academic communities complicated the meaning and measures of such concepts. It is thus necessary to first define and differentiate each of these words from the very outset.

Disaster refers to any suddenly occurring event that causes damage, ecological disruption, loss of human life, deterioration of health and health services which exceeds the capacity of the affected community on a scale sufficient to require outside assistance (Landsman, 2001). It is an extreme disruption of the functioning of a society that causes widespread human, material, or environmental losses that exceed the ability of the affected society to cope using only its own resources. Likewise, hazard refers to the probability of external [physical] event occurrence in a certain geographical area within a certain interval of time. It refers to a potentially damaging physical event, phenomenon, and/or human activity that may cause disaster (physical damage, loss of life or injury, economic losses, and environmental degradation) (Villagrán, 2006). Likewise, risk is the likelihood of occurrence (or probability) of the hazard (Cutter, 1996). It refers to the probability of harmful consequences/expected losses (such as deaths, injuries or property/livelihood/environmental damage) resulting from interactions between natural or

human-induced hazards and vulnerable conditions (ISDR, 2004). On the other hand, shocks refer to the impacts of sudden and unpredictable events (hazards) such as floods, earthquakes, fires, epidemics on livelihood of households. Furthermore, stresses refer to continuous, cumulative, and predictable pressures such as seasonal shortages and declining resources (Villagrán, 2006). In this study, shock refers to the widely experienced shocks (covariate shocks), local/household shocks (idiosyncratic shocks) and stresses that can have a cumulative negative effect on resilience of households to food insecurity. We have first made the shock exposure profile of households and the perceived coping abilities (or strategies) they pursue to avert food insecurity.

Households in the district have experienced a number of shocks and stresses including drought, hailstorm, epidemics (crop disease, livestock diseases, and human disease), heavy flooding, famine, price inflation, and war (war threat) over the years prior the survey time. Overall, all sampled households experienced a number of natural or manmade shocks prior the survey year.

Drought: Tigray is one of the most recurrent drought induced food security affected regions in the country (USAID, 2000; Tagel, 2008). Drought has remained the leading cause of disaster and human suffering in the region. Ahferom is one of the most drought prone districts in Tigray. The long historical trend of drought in the study area has not been properly recorded. However, the occurrence of drought in the area is a common phenomenon. Drought was the major shock factor affecting agricultural (crop and livestock) production and productivities in the area. Drought is a covariate shock factor that affects an entire area. The recurrence of drought has been becoming too short that it occurred almost once in every year in the last decades in the district. The recent (2015/16) drought affected the entire (99.25 percent) households in the study area. It destroyed the entire agricultural production and productivities. The result of qualitative data analysis also supports the quantitative data results. The focus group discussants unanimously revealed that “Drought is our big challenge; it has long been a norm in our area; it used to occur once every three years; now it occurs every year”. On the other hand, hailstorm occasionally affects crop production in the area. Though it is not as severe as drought, hailstorm particularly affects crop production and causes crop production failure in the area. The survey data revealed that significant (37.75 percent) number of farm households experienced hailstorm in the previous cropping season. The focus group discussants also reported that hailstorm had destroyed their crop production in the 2017 cropping year and made them to appeal for food aid.

A female farmer focus group participant in Sefeo *kebele* said that “Hailstorm destroyed my farm. I did not harvest anything; I now support my family by government food aid; I thank the government it saved my family”. The researcher witnessed that the government donated food aid to households whose crop production were destroyed by hailstorm in the highland and midland areas of the district. The discussants added that crop production failure, destruction of houses and physical property, displacement of households, soil erosion, and death of animals are the main consequence of hailstorm in the study area.

Crop and Livestock Disease: Agricultural production is the most important economic activity in the area. Almost all households are engaged in crop production and rear one or more type of livestock. However, crop and livestock diseases are important shock factors in the district. Tsetse-fly, Weed (*Striga*), Powdery mildew, Rodents and Stock borer are the main crop pests and diseases in the area. They affect and lead to crop production failure. These crop pests and diseases affected over half of the studied households in the area prior the survey year. The result of the survey indicated that the household, on average, lost 1.3 quintals of grain due to crop disease infestation. Foot and Mouth Disease, Lymphangitis, Newcastle disease, Internal and External Parasite, Black leg and Anthrax are the most prevalent livestock diseases deteriorating livestock production and productivity in the area. Over 30 percent households experienced livestock disease last year. Climate change, shortage of rainfall and grazing land, lack of vaccination and poor livestock production management are the main causes of livestock disease and death in the area. The discussants consistently reported that livestock death, emaciating livestock bodies which lower their market price, and reduced production and productivities are the resultant consequences of the widespread livestock disease in the area.

Human Disease and Death: There is a direct relationship between health and wellbeing. Healthy societies have a significant contribution to overall national development through direct participation in the economic sector and indirectly via little health sector budget utilization (Degefa, 2005). The health office of the district reported that Acute Upper Respiratory Infection (AURI), Malaria (unspecified), Gastritis (*Duodenitis*), infectious, Parasitic, Oral trush (OT), Amoebiasis, Malaria (*Plasmodium Vivax-PV*), Pneumonia, Malaria (*Plasmodium Palciparum*), skin infection, and dysentery are the top ten diseases in the area. The descriptive statistics showed that 10.75 percent of households had chronically ill members in

their household in the survey year. Furthermore, 2.25 percent of households lost their beloved family members in the last one year.

Food Price Inflation: Food price inflation was the fourth most widely reported shock factor in the area where significant number of households experienced it. The discussants also confirmed that the food price inflation was beyond their economic capacity to bear in.

Agricultural Inputs Price Inflation: Access to and application of modern agricultural inputs and technologies is important to improve agricultural production and productivity. The study indeed investigated whether or not farm households have access to modern agricultural inputs and technologies (fertilizer, improved seed, livestock hybrid, and farm tools) and found out that almost all households have access to such agricultural inputs in the area. Yet, the price of modern agricultural inputs and technologies has been increasing over time where 69.25 percent of the households experienced it. Agricultural input price inflation was the second most widespread shock factor households experienced in the area.

Heavy Flooding: The natural topography of the area is rugged and unsuitable to live in where the households and communities reside in hillsides and mountainous areas. The descriptive statistics showed that over 7.50 percent of the farm households experienced heavy flooding shock. The natural topography and deforestation are the casual factors of heavy flooding. Soil erosion, death of animals and damage of physical properties are the main consequence of the heavy flooding and wind in the area.

War Threat: Cultivable and grazing land is the first most important inter-household source of conflict in the district. The focus group discussants reported that farm land ownership claim and border are big sources of conflict in our community. Theft (of livestock and property) is also important sources of conflict in the district. The people in the lowland areas of the district (across the Ethio-Eritrean border) live under war threat and aggression. The discussants in the lowland *kebele* reported that the people lives under war threat and aggression. The Eritrean troops suddenly come tonight and take our livestock and other properties. The household survey, however, does not say anything about conflict in that no household reported that it had experienced skirmish with his neighbors. The next section summarizes shock exposure households experienced, severity and perceived ability of households to recover from it.

Table 17: Percent of households experienced various shocks in the last year

Shock factors	Overall	Highland		Midland		Lowland	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
1 Drought	99.25	113	28.46	208	52.39	79	19.9
2 Hailstorm	37.75	28	18.55	113	74.83	10	6.62
3 Crop disease	56.75	39	9.75	170	42.5	18	4.5
4 Livestock disease	30.50	38	9.5	56	14	28	7
5 Human disease	10.75	5	11.63	30	69.77	8	18.60
6 Heavy flooding	7.50	22	73.34	7	23.34	1	3.34
7 Farm input inflation	69.25	74	26.72	148	53.43	55	19.85
8 Food Inflation	41.00	41	10.25	101	25.25	22	5.50

Source: Author`s computation

Shock Exposure Index (SEI): The study measured the shock households experienced using shock composite index. The shock index takes into account the number of shocks (a dichotomy variable equal to 1 if the household experienced shock and 0 otherwise) households experienced and their severity. The severity of the shock was calculated using an ordered response of households to the ordinal severity question of “How severe was the impact of the shock on your income and food security?” The possible responses of the respondent to the severity question were hierarchically ordered on a scale of 1 to 5 where 1 refers to none, 2 refers to slight impact, 3 refers to moderate impact, 4 refers to strong impact, and 5 refers to worst ever happened. The shock exposure index is thus a weighted average of shocks households experienced multiplied by the perceived severity of the shocks (see Table 18). In fact, the study first enlisted out all the shock factors occurred in the study area. It then ordered according to their importance and considered the first eight such important natural and manmade shock factors as drought, hailstorm, heavy flood, livestock disease, crop failure, human disease & death, food inflation, and farm input inflation to compute the shock exposure index. The survey result indicates that all households experienced one or more shocks over the preceding survey year. The study calculated the shock exposure index as follows:

$$SEI = D * SD + H * SH + F * SF + LD * SLD + CF * SCF + HD * SHD + FI * SFI + FII * SFII$$

Where SEI= Shock Exposure Index; D=Drought; SD=Severity of Drought; H=Hailstorm; SH= Severity of Hailstorm; F=Heavy Flood; SF= Severity of Heavy Flood; LD=Livestock Disease; SLD= Severity of Livestock Disease; CF=Crop Failure; SCF= Severity of Crop Failure; HD=Human Disease; SHD= Severity of Human Disease; FI=Food Inflation; SFI= Severity of Food Inflation. The result of the survey shows that the sampled households, on average, experienced 12.83 shocks one year prior the survey time.

Perceived Ability to Recover from Shocks Index: The index estimates the ability of households to recover from the typical types of shocks they experienced last year. The perceived ability of households to recover index was computed using the ordered responses of the households to the ordinal perception question of “To what extent were you and your household able to recover?” The possible responses of the respondent to the perceived ability of the household to recover from such shocks were hierarchically ordered on a scale of 1 to 5 where 1 refers to did not recover, 2 refers to recovered but worse off before, 3 recovered to same level as before, 4 refers to recovered and better off, and 5 refers to not affected at all. The perceived ability to recover index is the mean value of the response of the respondents to the recovery question across all shocks households experienced. The result of the survey indicates that the average value of the responses to the ability of households to recover across all of the shocks households experienced was equivalent to 4.10625.

However, all households did not experience the same types of shocks of the same severity equally. The study thus created a shock exposure correction index to measure ability of households to recover from shock exposure. This correction index assumes that households experienced the same shock exposure and hence it is possible to compare them all across the column. To do so, a linear regression of the average ability-to-recover on the shock exposure index was run. This linear regression of the average ability to recover on the shock exposure index provided the ability-to-recover (ATR) by which an increase of 1 unit in the shock exposure index can be expected to change the ability to recover index. The estimated empirical equation of the ability to recover was:

$$\begin{aligned} \text{ATR} &= \beta_0 + \beta_1 \text{shock index} - \text{shock exposure} \\ \text{ATR} &= 5.02 - 0.72 \text{shock index} - \text{shock exposure} \end{aligned}$$

This empirical equation indicates that the higher the shock households exposed, the lower the ability of the households to recover; i.e. when the shock index increases by 1 unit, the ATR decreases by 0.72 (the coefficient on the shock exposure is negative). The study calculated the corrected recovery index as follows:

$$\begin{aligned} \text{ATR}_{\text{corrected}} &= \text{ATR} - 0.72(\text{average shock index} - \text{shock exposure}) \\ \text{ATR}_{\text{corrected}} &= \text{ATR} - 0.72 * (12.875 - \text{shock exposure}) \end{aligned}$$

This 12.875 is the mean value of the shock exposure index. This corrected ATR index value indicates that individual households who experienced shock exposure below the mean value of the shock exposure index would have a downward adjustment of its value and those households

who experienced above the mean value of the shock exposure index should go an upward adjustment.

Table 18: Shock exposure and ability of households to recover from shocks

	Indicators	Observations	Mean	Std. Dev.	Min	Max
1	Shock exposure index	400	12.828	5.204	3	27
2	Shock exposure index ratio	400	0.128	0.052	.03	.27
3	Recovery index	400	32.85	3.28	24	40
4	Recovery index ratio	400	4.11	0.41	3	5
5	ATR index	400	-4.22	3.75	-14.42	2.86
6	Corrected ATR	400	-4.182	7.49	-24.59	9.97

Source: Author`s computation

6.5. Resilience Capacity Analysis

6.5.1. Food Access Index (FAI)

This indicator measures capacity of households to access food. This study uses income and non-income indicators to measure the capacity of households to access food. It specifically used income, consumption expenditure, HFIAS, and number of coping strategy to measure it. The study computed the average income and consumption expenditure using income and consumption expenditure primary dataset gathered using semi-structured questionnaire.

Income: The total household income is the aggregate measure of the outcome of all the activities in which the household is engaged in (FAO, 2016). It permits households to obtain goods and services. Higher income possibly leads to greater savings, which could be important during the post-shock recovering phase (FAO, 2016). This cash income data constituted all agricultural and nonagricultural income households earn annually. The agricultural income refers to the cash income households earn from cash crops (such as hop plant, vegetables and fruits), livestock and livestock products. The nonagricultural income referred to all other sources of income including state transfers and aids, pensions, remittance (from relatives/friends/neighbors), wage income, weaving, petty trade, firewood and charcoal selling, and stone vending. The total average income of the studied households was ETB 24515.74 per year. The annual average income of each household was about USD 1015.56 (converted at that time exchange rate of 24.14). Furthermore, each household member earns around 184.12 USD per annum. The average per capita income per day was about USD 0.5058. This per capita income per day is less than the internationally accepted level (1.25 USD per day).

Consumption Expenditure: Consumption expenditure households make usually depends on their income. That is the higher the income households have, the higher they expend. This study used food consumption expenditure households made prior to the survey year. The total average expenditure the households made to purchase food was equal to ETB 12664.81 per year. This means each household had, on average, spent about USD 524.64 (converted at that time exchange rate of 24.14) annually to buy food items. Furthermore, each household member had, on average, spent around 95.38 USD per annum. That is, the average per capita expenditure for consumption was about USD 0.262 per day. This descriptive statistics demonstrates that over half of the annual income they reap goes to buy food consumption.

Household Food Insecurity Access Scale (HFIAS): HFIAS measures the adequacy and quality of food access as well as uncertainty and anxiety of households over insecure access to food (USAID, 1992; and Coates et al., 2007). The indicator is essentially constructed to measure the access dimension of food security. It is a continuous measure of the degree of food access in the household in the past four weeks. It captures feelings of uncertainty and anxiety over food, perceptions of insufficient quality and quantity of food, reductions of food intake and its consequences in the household and feelings of shame.

The HFIAS questionnaire consists of nine occurrence questions hierarchically increasing level of severity of food insecurity (food access); and nine follow up “frequency-of-occurrence” questions to each occurrence question to determine how often the condition occurred. The interviewer must skip the frequency-of-occurrence question unless the respondent reports that the household experienced the food insecurity condition described in the corresponding occurrence question in the previous four weeks (30 days) (Coates et al., 2007). The researcher first calculated the HFIAS score variable for each household by summing the codes for each frequency-of-occurrence question. Before summing the frequency-of-occurrence codes, the researcher coded the frequency-of-occurrence as 0 for all cases where the answer to the corresponding occurrence question was “No” (i.e., if Q1=0 then Q1a=0, if Q2 =0 then Q2a=0, and so on). HFIAS generates a single statistical score ranging from 0 to 27 to measure household food security status. The maximum score for a household is 27 where the household response to all nine frequency-of-occurrence questions was “often”, coded with response code of 3; the minimum score is 0 (where the household responded “No” to all occurrence questions where the interviewer skipped all frequency-of-occurrence questions and subsequently coded

them as 0. The higher HFIAS score hence indicates more food insecurity experience of the household. The lower score indicates the less food insecurity experience of the household.

The average HFIAS Score ($\frac{\text{(the Sum of HFIAS Scores in the sample)}}{\text{Number of HFIAS Scores (i.e. households) in the sample}}$) = 12.83. The highest HFIAS score was equal to 26 and the lowest was 0. The score indicates that only 30 (7.5 percent) of the studied households have scored 0 HFIAS; i.e. they experienced none of the nine HFIAS indicator questions.

Shock Coping Strategy: Coping strategy is another important indicator of food security. The strategy measures the behavioral responses (coping strategies) households take to manage shocks and stresses. It simply counts the number of potentially available coping strategies people can pursue when they are exposed to shocks and stresses. Coping strategies are hierarchically ordered based on their reversibility and commitment of domestic resources (Watts, 1983). Modest dietary adjustments are easily reversible strategies that do not jeopardize long-term household livelihoods. Extreme coping strategies people take suggest more serious (adverse) long-term livelihood consequences (Maxwell and Caldwell, 2008). Coping strategies may vary contextually (Jones et al, 2013). They are also unequally accessible to all households (Coates et al., 2007). Coping strategy here represents the number of available coping strategies households can potentially adapt and take it to resist and cope with shocks and stresses. It does not consider whether the household has adopted a specific coping strategy or not (ex-post); instead it counts the number of potentially available coping strategies to the household (ex-ante). The larger the number of coping strategies households can potentially use the resilient they are. The result of the survey indicates that the sampled households have, on average, 5.23 coping strategies they can adopt whenever they need to do so.

The study has run a principal component analysis to estimate the food access latent variable. Table (19) presents the factor loadings (weights) between each variable and food access in the entire sample population. The magnitude of the loading factors (weights) indicates the relative contribution of each variable to food access. The factor loading indicate that the contributions of all variables are important to estimate food access. The high correlation among the income and food access capacity indicators (Table 19) produced a latent variable that fits the common pattern in the data. The overall food access index score equals to 0.53. The model further indicates that the numbers of available coping strategies households can potentially use are

important to access food during crises. The households actually use such coping strategies as PSNP (work-for-food and free food aid), eating inferior food, withdrawal of savings, livestock sale, seasonal migration (wage labor), and remittance in order of their importance during food crises. Cash income is the least available resources to access food in the area.

Table 19: Mean Values and Weights of Food Access indicators and variables (n=400)

Variables	Mean (\bar{X})	Std. Dev. (S)	Normalized Values	Weight (β)	Index Score
1 Cash income	24515.74	16598.28	0.02	0.6442	0.01
2 Consumption expenditure	12664.81	6077.01	0.05	0.7558	0.04
3 HFIAS Score	12.83	5.30	0.04	0.6322	0.02
4 Coping strategy	5.23	1.65	0.61	0.7488	0.45
Food Access Index					0.53

Source: Author`s computation

6.5.2. Access to Basic Services (ABS)

Schools, health centers, water, and electricity and nearby markets are important dimension of resilience. First, the capacity of generating income from assets is constrained by access to market, as well as non-market institutions, public service provision and public policy (Dercon et al., 2004). Second, it determines risk exposure of households. Third, the relationships between state and society assume a relevant role in adaptation mechanisms (FAO, 2016). Public service provision is usually beyond the control of the household. It is, however, a key factor of resilience of households to food insecurity. It determines access of households to livelihood assets. It also affects the capacity of a household to manage risks and respond to recurrent shocks and stresses (Alinovi et al, 2010). That is they affect almost all asset stock of farm households either positively or adversely. ABS constitutes both access to services and the quality of access to such services (FAO, 2016). ABS here constitutes and measured by physical access to health post, potable water, access to primary school, electricity, alternative cooking energy, access to road; telecommunication, veterinary center, and credit services.

Health Facility: There is a direct relationship between health and wellbeing (Degefa, 2005). Health here is a continuous variable used to measure the distance (in kilometers) of the home of the household from the nearby health post. The descriptive statistics shows that great majority (89.50 percent) of the households have access to health post where the average distance of the health post from the home of households was equal to 2.63 kilometers.

Potable Water: Access to adequate and safe water supply is a fundamental human and democratic right. It has also considerable health and economic benefits to households. There is also a strong nexus between food security and access to adequate and safe water supply. Potable water in our study is a continuous variable measuring the time households take to collect water (walking to and from the nearest water point plus queuing). The descriptive statistics shows that great majority (90 percent) of the households have access to potable water points where the sampled households, on average, spent half an hour to fetch safe water from the water points.

Electricity: In Ethiopia, the government is the main responsible agent to develop the energy sector and supply electric power. To this end, rural electrification sits at the center of the subsequent plans of the government. Electricity here is a dummy variable indicating whether households have access to it or not. The survey results show that only 24 percent of the sampled households, many of whom live in the small rural towns, had access to electricity. Contrary, 76 percent households had no access to electricity. The study interestingly found that majority (79.25 percent) of the households used solar (lamp) lightening energy.

Cooking Energy: Firewood is the main source of household energy in rural Ethiopia. This long lasted household energy dependency on firewood and charcoal caused mass deforestation and alteration of land use system in the country. It has reduced the vegetation coverage of the country at alarming rate. The government has devised a green development policies and strategies to curve the mass natural resources base depletion. The energy development and supply policies and strategies mainly intend to electrify the rural areas through hydroelectric power energy, wind energy, geothermal energy, solar energy and biofuel energy generations and use of improved household cooking energy. Cooking energy here is a dummy variable capturing cooking energy of households. The result of descriptive statistics shows that majority (67.50 percent) of the sampled households did not have improved cooking energy and hence relied on firewood and charcoal (animal dung/straw/firewood/charcoal). Only 32.5 percent of households had access to alternative (such as modern stoves) sources of cooking energy.

Telecommunication: Access to and ownership of telecom services (such as mobile and fixed telephone) facilitates information exchange and communication amongst households and social service providers. The rural people accesses telecom services either through public (fixed phone) or mobile networks. The public (usually wireless) telecom service is limited to small rural towns and dysfunctional in many circumstances. Evidently, 94 percent of the households

had no access to public (fixed) phones. On the other hand, the survey result shows that vast majority (93 percent) of the households had mobile phones. Only very few (7 percent) of households did not have mobile phone. We have hence used mobile ownership to measure access of households to telecom services. This telecom is a dummy variable capturing telecom (mobile cellphone) device ownership of anyone of the household members. It equals to 1 if anyone of the household members owns a mobile phone and 0 otherwise.

School: Rural households most often acquire knowledge/education through adult literacy programs, formal education, training programs and other means of knowledge acquisition. We have here used primary school to measure access to school. School is a continuous variable measuring access to primary schools.

Road Networks: Road is a basic physical infrastructure which affects almost all dimensions of livelihood. Access to road facilitates market exchange of goods and services and eases government social service delivery to the people in need of it. Government development initiatives and public service delivery, implicitly or explicitly, benefit farm households who live along the course of the road networks. In other words, government service centers are usually located at the road-heads. Far distance of the home of the household from the road explicitly implies poor access to public services and farm inputs. Road here is a continuous variable capturing household access to modern (all-weather gravel/asphalt) road networks. It measured the distance of the home of the household from the main (nearby) road in kilometers. The result of the descriptive statistics shows that majority (88.25 percent) of the households have access to road transportation service. The sampled household, on average, lives 1.673 kilometers away from the main (nearby) road while the minimum and maximum distance between the main road and the home of the households equals to 0.1 and 5 kilometers respectively. Only 11.75 percent households perceived that they did not have access to modern road transportation services.

Credit Service: It has long been recognized that credit is a powerful financial instrument to lift the rural poor out of abject poverty (Doreen and Philip, 2014) and food insecurity. Credit enables farm households to increase their agricultural productivity through adoption of modern (new) agricultural technologies and inputs such as high yielding seeds and chemical fertilizer (Zeller and Sharma, 2000). Credit here refers to the total credit (in cash or in kind) households borrowed from formal or informal in the last five years. The survey result revealed that the sampled households, on average, borrowed 5922.462 ETB in the last five years. The survey

further shows that almost all (97.75 percent) households have access to financial (saving and credit) institutions. Only negligible number of the sampled respondents perceived that they did not have access to financial institutions. Likewise, the financial institutions provide saving and credit services to households in need of it. The survey shows that over half of the households borrowed credit (in cash or in kind) from either formal or informal in the last five years. On the other hand, almost half of the sampled households did not borrow any credit.

Veterinary Center: Livestock production is the second most important agricultural activity in the area. Veterinary service provision is therefore important to improve livestock production. Veterinary service here is a continuous variable measuring the distance (in kilometers) of households from the nearby veterinary center. The survey result indicates that the veterinary center is located, on average, 3.2 kilometers away from the home of the sampled households. That means each household has to walk 3.2 kilometers to receive such veterinary services as vaccination, antibiotics, deworming, and animal supplementary feed in the area.

Security Perception: The political economy literature of food security assumes that political stability is bedrock to livelihood development and food security. This variable captures the political security and safety perception of households. It measures the general security and safety perception of households from crime and violence. It equals to 1 if the households feel that they are secure/safe from any crime and violence at their home/locality and 0 otherwise.

The loading factors shows that all of the variables have a common pattern demonstrating the positive impact of health post distance, fetching time, electricity, alternative energy, telecom access, school distance, road distance, total credit and community police on the basic service access latent indicator. On the other hand, the veterinary center distance negatively affects the latent variable. It is degrading livestock production and livelihood of the households. The distance of health post distance, water points, schools, road, and veterinary centers have lower contribution to the latent variable. Likewise, electricity, alternative energy, telecom services and community police have similar contribution to the latent variable. The basic services access index equals to 0.44.

Table 20: Mean values and loading factors (weights) of access to basic services variables (n=400)

	Variables	Mean (\bar{X})	Std. Dev. (S)	Normalized Values	Weights (β)	Index Score
1	Health post distance (in kilometer)	2.63	1.92	0.162	0.52	0.086
2	Fetching time (in minutes)	29.66	18.89	0.053	0.80	0.042
3	Electricity access (binary)	67.04	23.73	0.042	0.66	0.028
4	Cooking energy (binary)	52.03	32.70	0.036	0.73	0.027
5	Telecom access (binary)	88.69	20.94	0.096	0.71	0.068
6	Primary school distance (in kilometer)	2.24	1.56	0.377	0.59	0.240
7	Road distance (in kilometer)	1.67	1.47	0.667	0.54	0.365
8	Total credit (in ETB)	2916.81	4350.11	0.000	0.94	0.000
9	Veterinary center distance (kilometer)	4.5	4.08	0.93	-0.56	-0.52
10	Security sense (binary)	90.43	19.70	0.192	0.65	0.1287
Basic Services Access Index						0.44

Source: Author's computation

6.5.3. Agricultural Assets (AA)

Agriculture mainly constitutes crop production and livestock rearing; agricultural technologies and farm inputs used to improve it. Agricultural productivity enhancement basically requires access to and the use of modern agricultural technology implements and tools, farm inputs such as improved seed varieties, chemical fertilizer, irrigation (water), modern pest control methods, and supporting institutions and economic policy environment (Hazell, 2009). Farm inputs constitute the major elements of extension package (fertilizer, improved seeds, pesticides, herbicides) and cultural practices (Belay, 2003). Agricultural asset here captures the total agricultural (crop and livestock) production and the level of modern agricultural technology implements and farm inputs households used to improve their farm productivity.

Crop Production: Land is a common resource in the household. All members of the household shares every resource imbedded in the land and the income households generate from it. Agricultural (crop) asset could have been computed using the monetary value of the land households own. However, the FDRE constitution stipulates that land is a common property of the people of Ethiopia and shall not be subject to sale or any other means of exchange. In fact, it is impossible to compute the market price of farmland households own. The study, instead, used the monetary value of crop households produced on the land they own. It has first computed the annual production of each crop each household harvested last year. It then estimated the monetary value of each crop the household harvested and added them up to derive the monetary

value of the total annual crop production. The study finally multiplied the monetary value of the total annual crop production by ten years to estimate the monetary value of the farm land each household owns. The descriptive statistics shows that the average monetary value of the crop households produce on the crop land they own was equal to ETB 198061.4. This means the farmland each household holds on is equal to ETB198061.4.

Livestock Production: Livestock production is the second most important agricultural activity in the area. It is a source of pulling power, cash income, supplementary food, and means of transport to a household. It is also a means of food security during crop failure and other calamities (Habtemariam et al., 2002). Households who own large numbers of livestock are expected to be resilient to food insecurity and vice versa. The descriptive statistics revealed that majority of the households owned one or more of livestock. Only 10.5 percent households did not own any type of livestock during the survey time. The study here used the monetary value of livestock households own to compute the agricultural asset variable. The survey result shows that the average monetary value of the livestock households own was equal to ETB 23847.54.

Agricultural Technology Stock: Agricultural technology stock here refers to modern agricultural implements and tools households accumulated to operate its farmland. It is a continuous variable used to measure the monetary expenditure households made to buy all the agricultural technologies (implements and tools) to improve their farm production. The survey result indicates that the total average monetary expenditure the sampled households made to buy agricultural assets was equal to ETB 4069.32.

Seed: Access to and use of improved seed variety is one of the most important necessities of agricultural inputs to improve crop production and productivity. Seed here is a dummy variable used to measure whether households have used improved seed variety or not in the previous cropping year. It equals to 1 if the household used improved seed varieties in the previous cropping year, and 0 otherwise. The survey shows that 76.25 percent of the households used improved seed variety last cropping year. Ironically, significant (23.75 percent) number of the households had no access to and failed to use improved seed variety in the last cropping season.

Chemical Fertilizer: Access to and use of chemical fertilizer is one of the most important necessities enhancing agricultural productivity factors. Farmers have long been used it to manage and improve their farmland (soil) fertility in the area. Chemical fertilizer is a continuous

variable measuring chemical fertilizer households applied per hectare last year. The survey indicates that the sampled households applied 148.087 kilogram per hectare in the last cropping year. It further indicates that almost all households applied chemical fertilizer to improve their crop productivity last cropping year.

Pesticide: Pesticide application is one of the most important crop pest infestation management methods. It helps households control their crop production from pest and pest infestation. Pesticide here is a continuous variable measuring the quantity of pesticide households applied per hectare in the previous cropping year. The survey result indicates that the households, on average, applied 0.96 liter pesticide per hectare last year. It also indicates that 71.5 percent of the sampled households applied pesticide to protect and manage crop pest infestation and disease last year. Only 28.5 percent households did not apply pesticide last year.

Herbicide: Unless managed, weed adversely affects and lowers crop production and productivity. Weeding and weed management is hence important factor of crop production management. Herbicide is a continuous variable indicating the quantity of herbicide households applied per hectare of farmland to manage crop weed and weed infestation in the previous cropping year. The survey indicates that the sampled households, on average, applied 0.80 liter of herbicide per hectare of farmland in the cropping year. It further revealed that 77.25 percent households did not apply herbicide on their farm last year.

Irrigated Land Ratio: Irrigated land ratio is a continuous variable measuring the ratio (ranging from 0 to 1) of irrigable land on the total farmland households possess. The result of the survey indicates that the mean irrigated land ratio of the sampled households was equal to 0.24. This shows that about 24 percent of the farmland of the sampled households own was irrigable land in the last one year. The survey further indicates that majority (69.29 percent) of the sampled households had no access to irrigation (water).

Veterinary Services: Veterinary service here is a dummy variable equal to 1 if the household received any veterinary service (such as vaccination, antibiotics, deworming, and animal supplementary feed) in the previous year, and 0 otherwise. The survey indicates that 84 percent households have received veterinary services from their nearby veterinary center last year.

Extension Contact: Modern agricultural technology supply per se is not enough. In fact, the MOA has long deployed three Development Agents (DAs) in each rural *kebeles* of the country to train and demonstrate farmers in crop production, modern animal husbandry, natural resource conservation, modern agricultural technology operations and extension methodologies (Belay, 2003). Extension contact refers to the number of visits DAs make to households per cropping year. Extension contact basically assumes that households who frequently contact DAs are likely to improve the production and productivity of their farm. Extension contact here is a continuous variable measuring the number of visits DAs made to their target farmers in the last cropping year. The result of the survey indicates that the DAs, on average, contacted their target farmers 14.23 times in the last cropping year. It also indicates that DAs visited about 23.66 percent of the farmers quarterly last year. They also contacted about 10 percent of the farmers fortnightly last year. They contacted about 60 percent of the farmers monthly last year.

The principal component analysis run to estimate the loading factors (weights) of the agricultural asset latent variables demonstrates that all of the variables have positive impact on the latent variable. Improved seed use, agricultural technology implements and tools, and irrigation ratio make the largest contribution to the overall agricultural asset households accumulate. The use of herbicide to manage weed makes the least contribution to the latent variable but still has a positive contribution. The agricultural asset index equals to 0.72.

Table 21: Mean values and loading factors of agricultural asset index indicators and variables

	Indicators (Variables)	Mean (\bar{X})	Std. Dev. (S)	Normalized Values	Weights (β)	Index Score
1	Cropland (annual monetary value)	198061.4	196259	0.001	0.661	0.001
2	Livestock (ETB)	23847.54	16203.17	0.013	0.633	0.008
3	Agricultural technology stock (ETB)	4069.32	6088.82	0.021	0.727	0.015
4	Seed use (binary)	69.66	24.46	0.286	0.875	0.250
5	Fertilizer (Kilogram per hectare)	145.87	72.50	0.087	0.658	0.057
6	Pesticide (liter per hectare)	0.68	0.78	0.015	0.637	0.010
7	Herbicide (liter per hectare)	0.18	0.42	0.072	0.379	0.027
8	Irrigation ratio (irrigable land/farmland)	0.07	0.14	0.013	0.704	0.009
9	Veterinary service (binary)	75.46	25.03	0.439	0.564	0.248
10	Extension contact (contact numbers)	13.94	7.16	0.140	0.653	0.091
Agricultural Asset Index						0.72

Source: Author`s computation

6.4.4. Social Capital (Social Safety-Nets-SSN)

Social capital denotes the quantity and quality of social resources (Smith et al, 2015). It basically refers to the rules and regulations, norms, obligations, reciprocity and trust embedded social relations, social structures and institutional arrangements that enable members of a social group to achieve their individual and community objectives (Moser and Felton, 2007). It includes both formal and informal transfers (FAO, 2016). Households who have good stock of social capital can easily cope from and respond to shocks and stresses. It enables households to use formal and informal social safety-net resources to manage idiosyncratic and covariate shock factors and stresses. Social capital here refers to bonding, bridging, and linking (Smith et al, 2015) capitals each of which helps households enhance their resilience capacity against shocks and stresses. Households who have high levels of bonding, bridging and linking social capital are inherently more resilient than those households who are imbedded with one or none of such social capitals (Aldrich, 2012).

Bonding social capital: It refers to the linkage between community members. It involves principles and norms such as trust, reciprocity, and cooperation between community members to help each other to cope with and recover from shocks (Smith et al, 2015). Membership on local associations and mutual (or informal) support (like labor, oxen, food, seed, and money) are typical indicators of bonding social capital. Bonding social capital here in our study measures membership of households on formal and informal local associations and assistances they provide to and receive from government and nongovernmental organizations, relatives and nonrelatives last year. The study used membership on cooperative organizations and farmers/women/youth associations, mutual support and exchange of labor, oxen, food, and seed amongst households to generate social capital index.

Social Support: The people in the study area have an imbedded culture of social support and social responsibility. They have a shared value of mutual support and exchange of labor, oxen, food and seed amongst each other. They also contribute social support to and receive from their relatives and nonrelatives living within and outside the area during shocks and stresses. Social support here in our study refers to the annual social support households contribute to the needy people (charity), church, marriage and engagement, mirage and funeral ceremonies. It is a continuous variable measuring the annual monetary expenditure households

contribute to churches, charity, marriage and engagement, mirage and funeral ceremonies. The larger the contribution households made, the better the social capital they imbedded in. The survey indicates that the sampled households, on average, contributed ETB 1226.6 last year.

Bridging social capital: Bridging social capital connects members of one community (group) to other communities (groups). It often crosses ethnic (racial) lines, geographic boundaries, and language groups, and can facilitate links to external assets and broader social and economic identities (Wetterberg, 2004). Households and communities who have better external ties and exposure to the wider social world can easily respond to and recover from covariate shocks (such as drought) which often exhaustively deplete local resources. Bridging social capital, in our study, refers to membership of households on formal government and nongovernment organization social support (productive safety-net) programs. It basically captures the total amount of assistance households received from governmental and nongovernmental organizations, and relatives/nonrelatives. It also captures the monetary and nonmonetary support households received from relatives and nonrelatives outside their locality. Households in the study area, irrespective of their wealth, make unreserved efforts to receive food aid and maximize the quota they receive from the PSNPs. The study here used the monetary value of the PSNP (in cash or in kind), free food aid households received and the remittance they received from relatives and nonrelatives outside their community last year. Bridging social capital is a continuous variable measuring the amount of social safety-net assistance households received from the PSNPs; and the support they received from relatives and nonrelatives outside their locality. The descriptive statistics revealed that the sampled households, on average, received ETB 7568 social safety-net and remittance last year.

Extension Training: The government of Ethiopia has long deployed development agents to the lowest administrative tier of the government who are responsible to train farmers on modern agricultural production technologies and techniques (such as fertilizer application, row cropping, harvesting and postharvest handling, early warning, natural resources management, marketing and entrepreneurship) and deliver technical information to their target farmers on agricultural meteorology, crop and livestock diseases outbreak, modern agricultural technologies and inputs, and market information. Such capacity building training and up-to-date information provision matters resilience capacity of households. Extension training here in our study indicates the number of capacity building training household members took on modern

agricultural production technologies and techniques; and agricultural meteorology and crop and livestock diseases outbreaks. It is a continuous variable measuring the number of training household members participated in to build their farming capacity and receive up-to-date information about modern agricultural production and crop and livestock disease outbreaks.

The principal component analysis run to estimate the loading factors (weights) of social capital variables demonstrates that all of the variables have positive impact on the latent variable except the food/seed/monetary support households received from nonrelatives living outside the study area. This negative impact of food/seed/monetary support households received from nonrelatives living outside on social capital demonstrates that the social support households receive is more of kinship type. It also contributes less to the social capital households built in. The analysis further demonstrates that membership of households on farmer/youth/women association has less contribution to the social capital bases. On the other hand, extension training, cooperative membership, social safety-net, and social support households receive have the highest contribution in order of their importance to the social asset stock of households.

Table 22: Mean values and loading factors of social capital indicators and variables (n=400)

Indicators (Variables)	Mean (\bar{X})	Std. Dev. (S)	Normalized Values	Weight (β)	Index Score
1 Social safety-net (annual safety-net HHs received in ETB)	6697.7	6238.34	0.0005	0.679	0.0003
2 Social support (annual social support HHs contribute in ETB)	1226.6	3392.64	0.0003	0.716	0.0002
3 Extension training (number of training HH members participated in)	7.37	4.11	0.485	0.978	0.475
4 Cooperative membership (binary)	57.32	17.69	0.96	0.883	0.849
5 Farmer/youth/women membership (binary)	72.09	24.86	0.855	0.43	0.380
6 Food/seed HHs received from relatives in the area (binary)	58.28	18.61	0.822	0.69	0.580
7 Food/seed HHs received from relatives outside the area	56.26	16.57	0.352	0.67	0.244
8 Monetary HHs received from nonrelatives outside the area	64.35	22.65	0.75	-0.38	-0.285
9 Labor/oxen HHs received from relatives in the area	79.21	24.67	0.32	0.59	0.211
10 Labor/oxen HHs received from nonrelatives outside the area	79.62	24.60	0.976	0.57	0.612
Social Capital Index					2.84

Source: Author`s computation

6.4.5. Livelihood Stability

Stability in food security literature is used to describe the stability of food supply. Livelihood stability here is considered as a cross-sectorial dimension of resilience. It captures the degree to which a household livelihood options vary over time. The stable the livelihoods of the

households, the resilient they would be. The value of the stability (latent) response variable was estimated by calculating crop losses, livestock losses, income stability, assistance dependency, assistance stability, and human health.

Crop Loss: This is a continuous variable measuring crop production loss (in kilogram) due to droughts, hailstorm, floods, and crop diseases, pest outbreaks, crop output deflation, agricultural input inflations, and water shortages. The survey indicates that over 76 percent of the households, on average, lost 2 quintals of crop harvest last year due such shock factors.

Livestock Loss: This is a continuous variable indicating the number of livestock death household experienced due to such shock factors as livestock diseases outbreak, drought, and shortage of animal feed. The survey result indicates that 30.5 percent of the households encountered livestock diseases last year. Moreover, 8 percent of the households experienced livestock death last year. These households, on average, lost 1.06 livestock in the survey year.

Human Health: This is a continuous variable measuring medical expenditure households made in the last one year. The larger the medical expenditure households made, the less the resilient they would be. The result of the descriptive statistics displays that the sampled households, on average, had spent ETB 463.27 for medical purposes in the last one year. The result further indicates that 63 percent of the households did not have medical expenditure.

Assistance Dependency: The FDRE issued national food security strategy in November 1996 (MOARD, 2010). The strategy stipulates that the government plans shall address causality food insecurity in the country. Food security programs such as PSNP, HABP, CCIP and resettlement were subsequently designed on the basis of that strategy to lift the poor out of the emergency relief system. PSNP was intended to assure food consumption and prevent asset depletion for food insecure households in chronically food insecure areas. The households in the study area have been receiving food aid since 2005. Assistance dependency refers to the extent of dependency of households on food aids and remittance. It is a continuous variable measuring the ratio of total assistance households received on the total income they generated last year. In fact, larger assistance ratio implies higher dependency of households on food aids and remittance and vice versa. The result of the survey indicates that the mean assistance dependency ratio of the sampled households was equal to 0.308. This shows that, on average,

over 30 percent of livelihood income of each household was deriving from PSNPs, food aid and remittance. It further indicates that only 11.5 percent of the sampled households did not receive food aid or remittance from elsewhere last year.

Assistance Stability: This is a dummy variable measuring the perception of households on the continuity of the PSNPs (work-for-food) and food aid one year prior the survey time. It equals to 1 if the households perceived that the assistance they received has been stable and 0 otherwise. The survey revealed that majority (80.5 percent) of the households perceived that the assistance (in cash or in kind) they received has been stable.

Dependency ratio: This is a continuous variable measuring the ratio of the number of dependents (age groups between 0-14 and 65 and above) divide by the productive age group (15-64). It is normally expressed as a percentage (Todaro and Smith, 2012). It exerts adverse impact on the productive age group of the households and threatens their food security. It is believed that the livelihood of households with higher dependency ratio is unstable compared to their counterparts. It adversely affects the stability of dimension of resilience capacity.

The estimated loading factors have similar patterns except dependency ratio. Crop and livestock loss and medical expense must have been negatively impacted on the stability of livelihoods. They yet have little impact on it which demonstrates that the shock factors have less impact on the stability of the livelihoods. In other words, despite the recurrent shock factors households experienced, they opted to stay on their farming. The negative coefficient of dependency ratio demonstrates that the unproductive members of the households are causing heavy livelihood instability in the area.

Table 23: Mean values and weights of livelihood stability indicators and variables (n=400)

	Indicators (Variables)	Mean (\bar{X})	Std. Dev. (S)	Normalized Values	Weights (β)	Index Score
1	Crop loss (kilogram)	1.47	1.71	0.292	0.50	0.146
2	Livestock death (numbers)	0.09	0.30	0.674	0.78	0.526
3	Medical expense (ETB)	171.41	718.15	0.033	0.77	0.026
4	Assistance ratio (ETB)	0.31	0.22	0.012	0.66	0.008
5	Aid stability (percentage)	69.96	24.52	0.064	0.66	0.042
6	Dependency ratio (ratio)	0.96	0.84	0.013	-0.4	-0.005
Stability Index						0.742

Source: Author`s computation

6.4.6. Adaptive Capacity (AC)

Adaptive capacity is an important dimension of resilience. It measures the capacity of households to adapt and react to shocks (Alinovi et al, 2010). It refers to the proactive and informed choices about alternative livelihood strategies based on changing conditions. It also refers to the flexibility of the household to respond to the long-term socioeconomic and environmental changes. Adaptive capacity constitutes and represented by livelihood diversification, access to infrastructure, asset accumulation, and social and human capital improvement of the poor to adapt to the long-term change (Smith et al., 2015). It measures the ability of the household to adapt to and react to negative livelihood outcomes. The study used such explanatory variables as soil fertility, landholding size, livelihood diversity, infrastructure (road), productive asset, nonproductive (consumer durables) asset, social safety-net, education, labor force, dependency ratio, cash income, savings, livestock, information access, number of coping strategies, and the number of assistance sources to generate the adaptive capacity.

Landholding size: The size of the land households hold determines their agricultural output. This study assumes that households who have relatively larger farmland can easily adapt to shocks and stresses than their counterparts. Landholding size here is a continuous variable measuring the size of farmland households possess. In fact, the average land holding size of the studied households was equal to 0.79 hectare.

Land Fertility: Land (soil) fertility households own conditions crop production and productivity which in turn affects their adaptive capacity. It was initially a categorical variable used to estimate the perception of households on their farmland. We, nevertheless, transformed it to percentage for the ease of statistical computation. The survey result of the study revealed that 52.3 percent and 37.8 percent of the studied households believe that the fertility of their farmland is medium and good relative to others respectively.

Livelihood Diversity: Households tend to diversify and enlarge their income sources (public, private, and so on) during a crisis. The more diversified livelihoods of households, the more resilient they are. Livelihood diversity is thus a continuous variable capturing the number of livelihood strategies households engaged in to generate income. The study first screened the main strategies of livelihoods households engaged in and ranked them according to their order of importance to the livelihood of the households. Agriculture, PSNP (work-for-food), wage labor, seasonal migration, food aid, and private business (petty trading) were the main

livelihood strategies in order of their importance in the area. The survey result revealed that the sampled households have, on average, engaged in three livelihood strategies while the minimum and maximum sources were 1 and 6 respectively.

Food Ratio: Food ratio refers to the cost households made to purchase food items. It adversely affects adaptive capacity of households. Food ratio is a continuous variable measuring the ratio (ranging from 0 to 1) of food expenditure on the total expenditure households made in the last one year. The result of the survey indicates that the mean food expenditure ratio of the sampled households was equal to 0.66. This shows that about 66 percent of the annual expenditure of the sampled household went to purchase food items in the last one year. This high food expenditure over nonfood expenditure tells us farm production is too small to cover the annual food needs of the households in the area.

Nonagricultural (Consumer durables) Asset: Consumer durable goods comprise fixed furniture and utensils the household owns. Nonagricultural asset here refers to the monetary expenditure households made to buy the nonproductive asset stock they accumulate. The result of the survey analysis indicates that the average monetary value of the nonagricultural asset the sampled households accumulated over time was equal to ETB 5533.695 while the minimum and maximum ranges from ETB 0.00 birr to 26500.

Productive (Agricultural) Asset: Productive (agricultural) assets refer to agricultural implements and tools the farm households possess. Productive asset here is a continuous variable measuring the productive (agricultural) capital stock at the household. It is the sum total of the monetary expenditure households made to buy the productive asset stock they accumulate. The result of the survey analysis indicates that the average monetary value of the productive asset the sampled households accumulated was equal to ETB 4069.32 while the minimum and maximum ranges from ETB 0.00 birr to 37800.

Social Safety-net: Social safety-net here refers to the total amount of assistance (social safety-net) households received from government, nongovernmental organizations, and relatives/nonrelatives within and outside their locality. The study here used the monetary value of the PSNP (in cash or in kind) and free food aid households received and the remittance they received from relatives and nonrelatives within and outside their community last year. The

descriptive statistics revealed that the sampled households, on average, received birr 6697.677 social safety-net support last year.

Education: The basic difference between educated and uneducated persons lies on the decision they make on their daily lives. Education affects the decision power of the head of the household to accept or reject modern agricultural technologies that can boost farm production and productivity. It is a social capital that impacts the ability of a household to take good and well-informed production and nutritional decisions positively (Babatunde *et al.*, 2007). It also affects how households manage resources and withstand to and cope from food insecurity. The study considered the highest formal education anyone member of the household attained to measure the role of education on adaptive capacity of households. Education is a continuous variable measuring the highest formal education household members attained in years.

Labor Force: Labor has long been recognized as a principal factor of production especially in agrarian society where smallholder agriculture makes the largest share of the economy. The sector favors active labor force and labor-intensive agricultural technologies over capital-intensive technologies which could substitute the former. Labor force here refers to the number of economically active members in the household who can readily engage in farm production operation and generate nonfarm incomes during offseason. The result of the survey indicates that the sampled households have, on average, 3.47 economically active members.

Dependency ratio: This is a continuous variable capturing the number of dependent members of a household on the economically active members. Dependency ratio lowers the adaptive capacity of households. It hence adversely affects the adaptive capacity of households.

Cash Income: This is a continuous variable capturing all agricultural and nonagricultural income households generated in the last one year. It is expected to enhance the adaptive capacity of households.

Savings: This is a continuous variable capturing cash savings households held at home and financial institutions. It measures the financial capacity of households to withstand resilience of households to food insecurity. Saving enhance the adaptive capacity of households.

Credit: The financial institutions provide saving and credit services to households in need of it. Credit is expected to improve the adaptive capacity of households to undesirable livelihood

outcomes. It is a continuous variable estimating the total credit households borrowed either from formal or informal institutions (in cash or in kind) in the last five year. The result of the survey shows that over half (50.38 percent) of the sampled households borrowed credit (in cash or in kind) either from formal or informal sources in the last five years. The rest half of the sampled households did not borrow any credit. The survey result further revealed that the sampled households, on average, borrowed 5922.46 ETB in the last five years. The survey further shows that almost all (97.75 percent) of the sampled households have access to financial (saving and credit) institutions. Only negligible number of the respondents perceived that they did not have access to financial institutions.

Livestock Asset: It is a continuous variable measuring the total number of livestock households own. Households rear livestock to buffer the hard times they experience. Households who own large numbers of livestock tend to have better adaptive capacity to food insecurity and vice versa. The number of livestock households own is aggregated using TLU.

Telecom Device: This is a dummy variable indicating telecom device (radio and mobile) ownership of households to access up-to-date information on agricultural meteorology, crop and livestock diseases outbreak, modern agricultural technologies and inputs, and [agricultural] market information. It fosters adaptive capacity of households to negative livelihood outcomes.

Coping Strategy: Coping strategy measures the behavioral responses (coping strategies) households take to manage shocks and stresses they are exposed to. It simply counts the number of potentially available coping strategies people can pursue when they are exposed to shocks and stresses. It is a continuous variable measuring the number of available coping strategies households can potentially adapt it to resist and cope with shocks and stresses. It does not consider whether the household has adopted a specific coping strategy or not (ex-post); instead it counts the number of potentially available coping strategies to the household (ex-ante). The larger the number of coping strategies households can potentially use the better they can adapt to changing undesirable livelihood outcome. The result of the survey indicates that households have, on average, 5.23 coping strategies they can adopt whenever they need to do so.

Corrugated House: Corrugated sheet roofed house ownership is an indicative of household wealth and adaptive capacity. This is a dummy variable indicating whether households have built corrugated sheet roofed houses or not. The result of the survey indicates

that vast majority (91.75 percent) of the sampled households has built corrugated sheet roofed houses and hence it may not make any difference.

Number of Rooms: This is a continuous variable indicating the number of rooms households own. The survey result indicates that the households, on average, have three rooms in their home.

Toilet: Household health has a direct correlation with household food security and livelihood improvements. Access to and use of latrines improves household sanitation and health. Latrine ownership here refers to the percentage of households who have constructed latrine regardless of the type of the latrine. The result of the survey show that majority of the sampled households has constructed latrines irrespective of their irregularity in use. On other hand, those who did not construct latrines, either due to financial problems or lack of awareness, were defecating around homestead, forest and river which contributes to poor sanitation.

PCA analysis was run to estimate the loading factors of adaptive capacity. The result of the analysis shows that all of the loading factors have similar patterns except dependency ratio and coping strategy demonstrating the positive impact of the variables on adaptive capacity of households. The negative coefficient of dependency ratio reveals that unproductive members degrade the adaptive capacity of households. Likewise, the inverse correlation between coping strategy and adaptive capacity shows that households who have good adaptive capacity tend to reduce the number of coping strategies they pursue. The study also shows that credit households borrow; land fertility, toilet ownership and agricultural asset stocks are the main determinants of adaptive capacity of households in the area. Moreover, the result of the analysis discloses that the contribution of food ratio, corrugated house ownership, cash income, and livestock to the adaptive capacity of households are minimal in the study area.

Table 24: Mean values and loading factors of adaptive capacity indicators and variables (n=400)

	Variables	Mean (\bar{X})	Std. Dev. (S)	Normalized Values	Weights (β)	Index Score
1	Landholding size (hectare)	0.78	0.37	0.005	0.537	0.003
2	Land fertility (percentage)	48.77	19.15	0.313	0.885	0.277
3	Livelihood diversity (number)	2.93	0.95	0.42	0.628	0.264
4	Food ratio (ratio)	0.66	0.13	0.0007	0.358	0.000
5	Nonagricultural asset (ETB)	5533.70	5338.76	0.0007	0.669	0.000
6	Agricultural asset (ETB)	4069.32	6088.82	0.0033	0.737	0.002
7	Social safety-net (ETB)	6697.68	6238.34	0.001	0.633	0.0007
8	Education (years)	9.88	2.70	0.37	0.553	0.205
9	Labor force (number)	3.47	1.55	0.129	0.534	0.069
10	Dependency ratio (ratio)	0.96	0.84	0.0002	-0.604	-0.000
11	Cash income (ETB)	24515.74	16598.28	0.002	0.490	0.0008
12	savings (ETB)	2467.98	5175.42	0.001	0.650	0.0007
13	Credit (ETB)	2916.81	4350.11	0.0002	0.943	0.0002
14	Livestock asset (TLU)	3.88	2.46	0.1445	0.486	0.07
15	Telecom device (Percentage)	58.96	19.20	0.314	0.646	0.203
16	Coping strategy (number)	5.23	1.65	0.606	-0.483	-0.293
16	Corrugated house (Percentage)	86.23	22.36	0.912	0.433	0.395
17	Number of rooms (number)	2.98	0.98	0.082	0.558	0.046
18	Toilet (Percentage)	77.95	24.86	0.741	0.799	0.592
Adaptive Capacity Index						1.836

Source: Author's computation

6.4.7. Absorptive Capacity (ABC)

Absorptive capacity refers to the ability of a household to minimize exposure to shocks and stresses (ex-ante) and to recover from shocks quickly when exposed (ex-post) (Smith et al., 2015; IGAD, 2015). Sound disaster risk management enhances absorptive capacity of households. This latent response variable was measured by shock preparedness and mitigation, informal safety nets, availability of insurance (health, crop and livestock insurance), capital accumulation (saving) and [physical] asset ownership explanatory variables.

Informal safety-nets: Informal safety-nets relates to the number of informal support (such as money, labor/oxen and food/seed) households received from local associations, neighbors, relatives and nonrelatives one year prior the survey time. Informal safety-net here is a continuous variable measuring the number of informal supports households received from local associations, neighbors, relatives and nonrelatives last year. The highest the number of the informal safety-net households received, the better they absorb shocks and stresses (ex-ante) and easily recover from shocks when exposed (ex-post).

Emergency Plan: This is a dummy (transformed to percentage) variable indicating the availability of local government disaster plan and emergency response program. It equals to 1 if the local government has government disaster plan and emergency response, and 0 otherwise. The survey result indicates that almost all (98.50 percent) of the sampled households live in provinces which have local government disaster plan and emergency response program.

Insurance: This is a dummy (transformed to percentage) variable measuring household access to [health and crop/livestock] insurance. It equals to 1 if the household has access to insurance services and 0 otherwise. The result of the survey indicates that about 69.25 percent of the sampled households had access to (mainly health) insurance services.

Ability to Recover: This is a continuous variable measuring the ability of the household to recover from shocks it experienced. The perceived ability of households to recover was computed using the ordered responses of the households to the ordinal perception question of able to recover. The perceived ability to recover index is the mean value of the response of the respondents to the recovery question across all of the shocks households experienced.

Financial Accumulation: This is a continuous variable indicating the cash (or monetary) savings households held in formal and informal financial institutions. It is derived using the total savings households held (in ETB) in at their disposal. The result of the survey indicates that majority (76.25 percent) of the sampled households had cash savings regardless of the institution they held in. The survey further indicates that the studied households have, on average, saved 3236.69 ETB in the last five years.

Livestock Asset: This is a continuous variable measuring the monetary value of livestock households own. The study first estimated the price of each livestock the household owned in the local market and summed it up to generate the monetary value of the livestock each household owns. It then divided the total monetary value of the livestock in each household to household size and finally derived the per capita monetary value of the livestock in each household. Households who have large per capita monetary value of livestock have better absorptive capacity to food insecurity and vice versa. The survey result shows that the average monetary value of the livestock households own was equal to ETB 23847.54 while the minimum and maximum were equal to 260 and 96,000 birr respectively.

Physical Asset Stock: Physical asset stock here denotes to the monetary expenditure households made to buy nonproductive (consumer durables) and productive (agricultural) assets they own. Consumer (durable) goods comprise fixed furniture and utensils the household owns. Productive (agricultural) assets refer to agricultural implements and tools the households possess. Physical asset stock here is thus a continuous variable measuring nonproductive (consumer durables) and productive (agricultural) asset stock they own. The result of the survey indicates that the sampled households, on average, have spent ETB 9603.015 to buy the consumer goods and productive assets they accumulate over time.

PCA analysis was run to estimate the correlation and relative contribution of each variable to the absorptive capacity latent variable. The output of the analysis shows that the variables have a positive contribution on the absorptive capacity except [crop, livestock and health] insurance. The negative coefficient of insurance on the absorptive capacity demonstrates that the sampled households have neither access to nor ability to use the insurance services. The analysis further indicates that physical asset stock; financial accumulation, informal safety-nets and the presence of emergency response plan are the main determinants of absorptive capacity in the area.

Table 25: Mean values and loading factors of absorptive capacity indicators and variables (n=400)

Indicators (Variables)	Mean (\bar{X})	Std. Dev. (S)	Normalized Values	Weights (β)	Index Score
1 Informal safety-net (number)	8.61	2.32	0.87	0.716	0.623
2 Emergency plan (Percentage)	97.14	11.63	0.59	0.679	0.401
3 Insurance (Percentage)	71.69	24.81	0.524	-0.452	-0.237
4 Ability to recover (index)	-4.18	7.49	0.021	0.546	0.012
5 Financial accumulation(ETB)	2467.98	5175.42	0.002	0.789	0.002
6 Livestock asset (ETB)	23847.54	16203.17	0.003	0.537	0.002
7 Physical asset (ETB)	9603.02	9176.49	0.0007	0.910	0.000
Absorptive Capacity Index					0.802

Source: Author`s computation

6.4.8. Transformative Capacity (TC)

This transformative capacity indicator of household resilience is related to government policies and regulations, infrastructure and formal safety-nets that are part and parcel of the wider social system in which households are embedded in (IGAD, 2015). It relates to the system-level changes that enable more lasting resilience (Smith et al., 2015). Transformative capacity is a latent response variable measured by calculating social capital of households and their access to

formal safety-nets, markets, infrastructure, communal natural resources and veterinary services. This study used the following response variables to generate and measure the transformative capacity latent variable.

Formal Safety-nets: The presence of and access to formal government and nongovernmental institutions providing food and nonfood assistance to households in need of it implies better policy environment to enhance and transform the livelihood of the poor. Formal safety-net is a dummy (transformed to percentage) variable indicating membership of households on formal government and nongovernmental organizations and institutions providing food and nonfood support and aids (PSNP) to needy households. It equals to 1 if the household is member of the PSNP and 0 otherwise. The result of the survey analysis points out that vast majority (80.5 percent) of the sampled households are members of the PSNP providing food and nonfood assistance to households in need of it in case of emergency.

Social Capital: Social capital here relates to the total amount of social safety-net assistance households received from governmental and nongovernmental organizations. It also refers to the monetary and nonmonetary support households received from relatives and nonrelatives outside their locality. The study here used the monetary value of the PSNP (in cash) and free food aid households received and the remittance they received from relatives and nonrelatives outside their community last year. Social capital is hence a continuous variable estimating the amount of social safety-net assistance households received from government and nongovernment organizations; and the support they received from relatives and nonrelatives outside their locality. The descriptive statistics revealed that the sampled households, on average, received ETB 7568 social safety-net and remittance last year.

Market Access: This is a binary (transformed to percentage) variable indicating market access of households to sale their agricultural (crop and livestock) production. It equals to 1 if households have perceivably access to market place and 0 otherwise. The result of the survey indicates that widely held (80.5 percent) sampled households have market access to sale their agricultural (crop and livestock) product. Only little households did not have market access.

Health: Health is a continuous variable used to measure the distance (in kilometers) of the home of the household from the nearby health post. The descriptive statistics shows the average distance of the health post from the home of the households was equal to 2.63 kilometers.

Potable Water: Potable water is a continuous variable measuring the time households take to collect water (walking to and from the nearest water point plus queuing). The descriptive statistics shows that the sampled households, on average, spent half an hour to fetch safe water from the nearby water points.

Electricity: Electricity here is a dummy (transformed to percentage) variable indicating whether households have access to it or not. The survey results show that only 24 percent of the sampled households, many of whom live in the small rural towns, have access to electricity.

School: The study used primary school to measure access to school. School is a continuous variable measuring access to primary schools.

Infrastructure (Road): Road is a continuous variable measuring household access to [all-weather gravel/asphalt] road network. It measured the distance of the home of the household from the main (nearby) road in kilometers. The survey result shows that vast majority (88.25 percent) of the households have access to roads. Only very few proportion of the households perceived that they did not have access to road services. Likewise, the household, on average, lives 1.67 kilometers away from the main (nearby) road while the minimum and maximum distance between the main road and the home of the sampled households equals to 0.1 and 5 kilometers respectively.

Credit: Credit here refers to the total credit (in cash or in kind) households borrowed either from formal or informal institutions in the last five years. The survey result revealed that the sampled households, on average, borrowed 5922.46 ETB in the last five years. The survey further shows that over half (50.38 percent) of the households borrowed credit regardless of the credit source (formal or informal) and nature (in cash or in kind) in the last five years. The rest half of the sampled households did not borrow any credit in the last five years.

Veterinary Center: Veterinary center here is a continuous variable measuring the distance (in kilometers) of the home of the households from the nearby veterinary center. The survey result indicates that the veterinary center is located, on average, 3.2 kilometers away from the home of the sampled households. That means each household has to walk 3.2 kilometers to receive such veterinary services as vaccination, antibiotics, deworming, and animal supplementary feed in the area.

Information device: This is a dummy (transformed to percentage) variable indicating telecom device ownership to access up-to-date information on agricultural meteorology, crop and livestock diseases outbreak, modern agricultural technologies and inputs, and [agricultural] market information.

Communal Natural Resources: This is a dummy (transformed to percentage) variable indicating household access to communal resources (grazing land). The outcome of the survey indicates that vast majority (92.75 percent) of the sampled households had access to communal natural resources (grazing land).

This transformative indicator of resilience captures the policies and regulations, infrastructure and formal safety-nets of the wider social system where households are imbedded in. PCA analysis was run to estimate the correlation and relative contribution of each variable to the transformative capacity latent variable. The result of the analysis shows that almost all variables have similar pattern which demonstrates a positive impact on the transformative latent variable. The result further demonstrates that credit households borrowed, access to grazing land, and membership on [formal] PSNP are the main determinants to transform the livelihoods in the study area. The inaccessible water schemes are militating against and slowing down the transformation pace.

Table 26: Mean values and loading factors (weights) of transformative capacity variables (n=400)

	Indicators (Variables)	Mean (\bar{X})	Std. Dev. (S)	Normalized Values	Weights (β)	Index Score
1	Formal safety-net (percentage)	69.96	24.52	0.064	0.820	0.053
2	Social safety-net (in birr)	6697.68	6238.34	0.005	0.392	0.002
3	Market access (binary)	74.43	25.03	0.064	0.42	0.027
4	Health center distance (kilo meter)	2.63	1.92	0.163	0.49	0.08
5	Water fetching time (in minutes)	29.66	18.89	0.053	-0.65	-0.034
6	Electricity (percentage)	67.04	23.73	0.042	0.63	0.027
7	School distance in kilometer	2.24	1.56	0.385	0.63	0.242
8	Infrastructure (road)-in kilometer	1.67	1.47	0.816	0.56	0.457
9	Veterinary center distance	4.50	4.08	0.049	0.58	0.028
10	Total credit (in ETB)	2916.81	4350.11	0.001	0.93	0.001
11	Telecom device (percentage)	58.96	19.20	0.105	0.51	0.054
12	Grazing land (percentage)	88.26	21.22	0.012	0.8522	0.01
Transformative Capacity Index						0.946

Source: Author`s computation

6.5. Resilience Capacity Decomposition

This section first computes the aggregate resilience index (R) and decomposed it to understand the whole resilience capacity of households in the study area. The separate calculation of resilience dimensions on the preceding sections proved that resilience is a multidimensional concept where a single variable has been relevant to estimate more than one latent indicator in the model. There may, however, be an endogeneity (i.e. the risk of causality between independent and dependent variables) in the model. That means the eight dimensions of resilience are not linearly dependent upon one another. It is indeed impossible to add the dimensions of resilience index scores calculated separately. The study, instead, calculated the aggregate resilience index using equation 6.7. The study found out that the aggregate resilience index of the households was equal to 3.815 (see appendix II). The aggregate index scores of resilience dimensions are presented below in Table 27. Households are more resilient to negative livelihood outcomes when they are healthier, better educated, and have more robust access to basic necessities and social amenities (Busby and Smith, 2014). Here, higher resilience index scores represent higher resilience of households to shocks and negative livelihood outcomes. The resilience indices mean values generally indicate that the sampled households have low resilience capacity in the area.

Table 27: Resilience indicators score and resilience mean values

	Resilience Indicators	Resilience Dimensions Index	Mean Values	Std. Dev.	Min	Max
1	Food access	0.53	0.001	1.42	-3.67	8.07
2	Basic services access	0.44	0.001	2.35	-7.32	7.66
3	Agricultural asset stock	0.72	0.002	2.62	-8.01	10.04
4	Social capital stock	2.84	0.007	2.66	-8.28	12.57
5	Stability	0.742	0.002	1.74	-4.11	13.83
6	Adaptive capacity	1.836	0.005	3.88	-10.25	12.46
7	Absorptive capacity	0.802	0.002	1.91	-9.74	8.10
8	Transformative capacity	0.946	0.002	2.58	-7.33	6.20
9	Resilience index [*]	3.815 [*]	0.002	4.59	-12.93	22.65

Note: The aggregate resilience index^{*} is not the summation of the indicator scores

Source: Author`s computation

The food crises resilience analysis frameworks lack clear cutoff points to categorize households into non-resilient and resilient ones. In such cases, mean values are usually used to categorize households into different strata. Mulat and Negussie (2013), for example, used the mean resilience index values to determine resilience status of households. They treated households

whose resilience index score fall below average as non-resilient and those households who scored above average are resilient. This study categorizes the households into less resilient and high resilient households using the average resilience index scores where households whose resilience index score fall below the average score are categorized as less resilient and those who scored above average are categorized as high resilient. The study further decomposed the resilience capacity on the basis of sex and livelihood strategy and food security status wise.

It has conventionally believed that male headed households have better access to and control over livelihood resources; and are indeed more resilient than their female headed households. The study confirmed that gender disparity undermines resilience capacity of households where male headed households become more resilient than their female headed counterparts. A similar resilience study in Somalia found opposite finding whereby female headed households are more resilient than their counterparts (FAO, UNCIF and WFP, 2014). The study area does have highland, midland and lowland distinctive agro-ecologies. The study indeed attested whether the resilience capacity of households varies agro-ecologically or not. It has found out that resilience capacity of households varies agro-ecologically where highland farmers are less resilient than their midland and lowland counterparts.

Households usually tend to diversify and enlarge their livelihood sources. The finding of the study is consistent with the conviction that postulates households who diversified their livelihood are more resilient to undesirable livelihood outcomes. The resilience capacity of households increases with increasing livelihood diversification. The average resilience capacity of households whose livelihood is single was equal to 0.33. Conversely, the resilience capacity of households who diversified their livelihood to three was increased to 0.58.

This study measured food security status of households using MFI and HFIAS techniques in the preceding chapters. MFI captures all dimensions of food security. HFIAS essentially measures the access dimension of food security. The study here attested the resilience capacity of households against their food security status. The study found out that almost all of the sampled households are multidimensionality [mildly] food insecure. Yet, almost half of the multidimensionality [mildly] food insecure households are resilient to adverse livelihood outcomes. Table (28) indicates that the resilience capacity of households decreases with increasing HFIAS status. That is the more the food insecure households, the less resilient they become. The Pearson chi-square test indicates that over half of the [mildly and moderately]

HFIAS food insecure households have high resilient capacity. This study infers that food insecure households are not necessarily fragile. This implies food security studies without due resilience capacity analysis do not provide true picture of livelihood condition of households.

Table 28: Resilience Capacity Decomposition

Variables		Mean	Less Resilient		High Resilient		P-value
			N	Percentage	N	Percentage	
Sex	Male	0.57	121	42.61	163	57.39	0.000
	Female	0.37	73	62.93	43	37.07	
	Total	0.52	194	48.50	206	51.50	
Agro-ecology	Highland	0.27	82	72.57	31	27.43	0.000
	Midland	0.61	82	39.42	126	60.58	
	Lowland	0.62	30	37.97	49	62.03	
Livelihood strategy	Farmers	0.53	183	47.16	205	52.84	0.002
	Wage laborers	0.08	11	91.67	1	8.33	
MFI Status	Mildly Food Insecure	0.51	194	49.11	201	50.89	0.029
	Moderately Food Insecure	1	-----	-----	5	100.00	
	Food secure	0.61	12	38.71	19	61.29	
HFIAS Status	Mildly food Insecure	0.56	24	43.64	31	56.36	0.002
	Moderately Food Insecure	0.58	81	42.19	111	57.81	
	Severely Food Insecure	0.37	77	63.11	45	36.89	

Source: Author`s computation

6.6. Chapter Summary

Resilience here is a latent variable made up of income and food access, access to basic services, agricultural asset, social safety-nets, livelihood stability, adaptive capacity, absorptive capacity, and transformative capacity indicators. This study employed PCA to reduce the number of variables and estimate the independent contribution (weight) of each variable to the resilience index. It first estimated exposure of households to shocks and stresses using shock index in order to understand and quantify their resilience capacity explicitly. The shock index takes into account the number of shocks households experienced and their severity. The households, on average, experienced 12.83 shocks last year. The study, next, computed each latent indicator of resilience capacity of households separately.

The food access indicator of resilience measures household access to food. This study used income, consumption expenditure; HFIAS score and number of coping strategy to measure household access to food. The loading factors shows that all of the variables have a common pattern demonstrating the positive impact each variable on the food access indicator. The factor

loadings further indicate that the contributions of all variables are important to access food. Access to basic services captures physical access to health services (health post), potable water, access to school; electricity, alternative cooking energy, access to modern road transportation; public telecommunication, veterinary services; and credit services. The loading factors show that all of the variables have a common pattern demonstrating the positive impact of each variable on the basic service access indicator. Agricultural asset captures total agricultural production and modern agricultural technology implements and farm inputs households used to improve their farm productivity. The PCA analysis of agricultural asset demonstrates that all variables have positive impact on the latent variable.

This study used such important variables as membership on cooperative organizations and farmers/women/youth associations, mutual support and exchange of labor, oxen, food, and seed amongst households; social safety-net, social support, and extension training to generate social capital index. The result of the model demonstrates that all of the variables have positive impact on the latent variable except the food/seed/monetary support households received from nonrelatives living outside the study area. It further demonstrates that membership of households on farmer/youth/women association has less contribution to the social capital bases. In contrast, extension training, cooperative membership, social safety-net, and social support households receive have the highest contribution in order of their importance to the social asset stock of households.

Stability captures the degree to which a household livelihood options vary over time. The study estimated the value of livelihood stability using crop and livestock losses, medical expense, income stability, assistance dependency, and assistance stability. The estimated loading factors of stability have similar patterns except dependency ratio. Crop and livestock losses and medical expense must have been a negative impacted on the stability livelihoods. They yet have positive impact on it which demonstrates that the shock factors have less impact on the stability of the livelihoods. Dependency ratio negatively affects stability of livelihoods. Adaptive capacity captured livelihood diversity, infrastructure (road), productive (agricultural) asset, nonproductive (consumer durables) asset, social safety-net, education, labor force, dependency ratio, annual income, cash savings, livestock, information access, number of coping strategies, and the number of assistance sources. The result of the model shows that all of the loading factors have similar patterns except dependency ratio and coping strategy demonstrating the

positive impact of the variables on adaptive capacity of households. The negative loading factor of dependency ratio reveals that households having large unproductive members degrade the adaptive capacity of the households. Similarly, absorptive capacity captured shock preparedness and mitigation, informal safety nets, availability of insurance, capital accumulation (saving) and [physical] asset explanatory variables. The output of the model shows that the variables have a positive contribution on the absorptive capacity except insurance. The negative impact of insurance on the absorptive capacity demonstrates that the sampled households have neither access to nor ability to use the insurance services. The analysis further indicates that physical asset; financial accumulation, informal safety-nets and the presence of emergency response plan are the main determinants of absorptive capacity in the area. Lastly, the study captured the transformative capacity of households using their social capital, formal safety-nets accesses, markets, infrastructure (basic services), communal natural resources and veterinary services. The result of the model shows that almost all variables have similar pattern which demonstrates a positive impact on the transformative ability of households.

The dimensions of resilience are not linearly dependent upon one another. It is indeed impossible to add the dimensions of resilience index scores calculated separately. The study, instead, calculated the aggregate resilience index using the observable variables altogether. The study categorized the households into less resilient and high resilient households using the average resilience index. It found that half of the sampled households were resilient while the rest were less resilient. The study measured food security status of households using MFI and HFIAS indicators. It demonstrated that almost half of the multidimensionality [mildly] food insecure households are resilient to adverse livelihood outcomes. The result of the analysis further indicates that the resilience capacity of households decreases with increasing HFIAS status. That is the more the food insecure households, the less resilient they become. Similarly, over half of the [mildly and moderately] HFIAS food insecure households have high resilient capacity.

7. CONCLUDING REMARKS AND POLICY RECOMMENDATIONS

7.1. Empirical Conclusion

This study centrally intends to estimate resilience capacity of rural households to food insecurity. It estimated livelihood asset endowments, multidimensional food security status of households and their resilience capacity to adverse livelihood outcomes. This study adopts sustainable livelihood and resilience integrated framework. The integrated framework emphasizes the necessity of resilience capacity of households which heavily relies on their access to and control over livelihood assets mediated by natural or manmade shocks, basic public services and social amenities (institutions and government policies) to pursue certain livelihood strategies to reduce food insecurity. The integrated framework enabled us to measure the livelihood asset endowment and multidimensional food security status of households and their resilience capacity in shock and stress prone areas. Cross-sectional survey study was conducted in six proportionately sampled *Kebeles* of Ahferom *Wereda*, Central Zone of Tigray National Regional State. The data were gathered from systematically selected 400 rural households using pre-tested semi-structured questionnaire. Descriptive and multivariate (MCA and PCA) techniques were employed to analyze the quantitative data. Qualitative data were also used to substantiate and support the quantitative data findings.

This study estimated livelihood asset endowment of households using asset index. Asset index close to zero imply low asset endowment while index scores close to one imply high asset endowment of households. The aggregate asset endowment analysis revealed that the households, on average, had 0.127 asset stock. This small livelihood asset stock indicates that the households are vulnerable to multitude of natural and manmade shock factors and undesirable livelihood outcomes. The MCA livelihood asset endowment analysis reveals that human capital and social assets are relatively abundant in the area. Nonetheless, gender inequality, family breakings, illiteracy, poor health, small family size and lack of appropriate agricultural training and demonstration are shrinking the human asset accumulation and exacerbating the existing structural food insecurity in the area. The human asset analysis further reveals that dependency ratio has a weak link with food security demonstrating that the perceived unproductive members of a household are not really unproductive.

Financial and natural asset endowments are the least readily available livelihood resources in the area. The multivariate financial asset endowment analysis demonstrates that financial asset factors such as cash income, bank account, gold jewelry accumulation, health insurance, crop failure insurance, and livestock households own are contributing contrary to the longstanding conviction that access to and accumulation of such financial resources enhance food security of rural households. That means cash income households earn basically goes to nonfood expenses. Likewise, gold jewelry accumulation intensifies food insecurity. The human health insurance fee households pay to the government did not bring about commensurate health service so far. Large livestock herd rearing is obstructive to enhance food security of households due to (1) shortage of grazing land; (2) expensive supplementary feed; (3) shortage of shepherd; and (4) covariate shocks. Only silver jewelry accumulation, savings, and credit households borrowed are making financial asset endowment differentiation in the area. The financial asset analysis further demonstrates that the credit households borrowed from formal and informal institutions is ineffective to enhance food security of households due to inappropriate usage and high interest rate in the area.

The separate natural asset endowment analysis shows that only land acquisition, soil fertility, land convenience, and hop plantation are important natural asset differentials in the area. The study further demonstrates that almost all households have access to land either through land distribution, redistribution, inheritance and other means of land transaction. However, the multivariate analysis demonstrates that farmland holding size does not create food security disparity between households. The rural poor started generating income from selling such forest and vegetation resources as firewood and charcoal, cactus, eucalyptus and hop plantation. Water resources endowment varies across the agro-ecology of the study area. There are relatively abundant surface and ground water resources in the highland and midland areas. In contrast, there exists surface and ground water scarcity in the lowland agro-ecological zone of the study area. Nonetheless, the multivariate analysis demonstrates that such access to and selling of natural asset factors as safe water, water resources adequacy, irrigation use; firewood and charcoal, cactus fruit, eucalyptus, grazing land and land holding size are less relevant to natural asset accumulation and food security disparity between households to-date.

The physical asset analysis constitutes nonproductive, productive (agricultural) assets, housing and basic public services asset categories. The multivariate physical asset accumulation analysis

reveals that the households had good stock of consumer (utensils) goods, basic agricultural implements and tools; potable water points, public transport, access to primary school and health posts; veterinary services, financial (credit and saving) institutions and services, and agricultural extension services. The analysis, however, demonstrates that the households lack access to and control over modern house appliances, modern agricultural productive technologies and tools. It further demonstrates that road networks, secondary and preparatory schools, telecom services, electricity infrastructure, and alternative cooking energy development are low in the area.

The study used multidimensional food security indicator to assess food security status of households. The indicator captures all dimensions of food security to measure it in totality. It uniquely categorizes households into food secure, mildly food insecure, moderately food insecure and severely food insecure. The multidimensional food security analysis indicates that none of the sampled households were multi-dimensionally food secure in the survey time. The absence of multi-dimensionally food secure households in the area reveals that high value food production and consumption is unthinkable to-date. The households are compromising quality food consumption. Almost all of the surveyed households were multi-dimensionally [mildly] food insecure a month prior to the survey. This high multidimensional (mildly) food insecurity prevalence demonstrates that a small deviation in agricultural production and the long-term productive safety-net program could push a significant percentage of households up into food security or may drag them down into moderate or severe food insecurity condition. It also illustrates that the households have homogeneous wellbeing and living standards. Only 1.25 percent of the sampled households were moderately food insecure in the survey time. Severe food insecurity prevalence was zero in the study area. This multidimensional food security analysis portrays that the existing structures and processes (institutions and policies) are not enabling the households to convert the livelihood resources they are endowed with into desirable [food secure] livelihood outcomes.

The study computed each of the eight latent indicators of food crises resilience capacity of households separately. The food access indicator of resilience measures household access to food. This study used income, consumption expenditure; HFIAS score and number of coping strategy to measure food access. The loading factors shows that all of the variables have a common pattern demonstrating the positive impact each variable on food access indicator. The

factor loading estimations further indicate that the contributions of all variables are important to food access. Likewise, it estimated households access to basic services using such observable variables as physical access to health services (health post), potable water, school, electricity, cooking energy, road access; telecommunication, veterinary services; and credit services. The loading factors show that all of the variables have a common pattern demonstrating a positive impact of each variable on the basic service access latent indicator. Agricultural asset captures the total agricultural production and modern agricultural technology implements and farm inputs households used to improve their farm productivity. The study used such observable variables as crop production, livestock production, agricultural technology stock, and farm inputs to compute the agricultural asset latent variable. The PCA analysis of agricultural asset variables demonstrates that all of the variables have positive impact on the latent variable.

The study used such factors as membership on cooperative organizations and farmers/women/youth associations, mutual support and exchange of labor, oxen, food, and seed amongst households; social safety-net, social support, and extension training to generate social capital index. The result of PCA analysis demonstrates that all of the variables have positive impact on the latent variable except the food/seed/monetary support households received from nonrelatives living outside the study area. The analysis further demonstrates that membership of households on farmer/youth/women association has less contribution to the social asset bases. On the other hand, extension training, cooperative membership, social safety-net, and social support households receive have the highest contribution in order of their importance to the social asset stock of households. The study estimated livelihood stability index using such variables as crop loss, livestock loss, medical expense, income stability, assistance ratio, aid stability and dependency ratio. The estimated loading factors of livelihood stability have similar patterns except dependency ratio. Crop and livestock losses and medical expense must have had a negative impacted on the stability of livelihoods. They yet have positive impact on it which demonstrates that the shock factors have less impact on the stability of the livelihoods. Dependency ratio negatively affects stability of livelihoods.

The study used such explanatory variables as livelihood diversity, infrastructure, productive (agricultural) asset stock, nonproductive asset stock, social safety-net, education, labor force, dependency ratio, cash income, savings, livestock asset, information access, number of coping strategies, and the number of assistance sources to generate the adaptive capacity of households.

The result of the model shows that all of the loading factors have similar patterns except dependency ratio and coping strategy demonstrating the positive impact of the variables on adaptive capacity of households. The negative loading factor of dependency ratio reveals that unproductive members of households degrade the adaptive capacity of their households. Absorptive capacity captured shock preparedness and mitigation, informal safety nets, agricultural insurance, capital accumulation and asset ownership explanatory variables. The output of the model shows that all variables have a positive contribution to the absorptive capacity except insurance. The negative impact of insurance on the absorptive capacity demonstrates that the sampled households have neither access to nor ability to use the insurance services. The analysis further indicates that physical asset stock; financial accumulation, informal safety-nets and the presence of emergency response plan are the main determinants of absorptive capacity in the area. The study captured the transformative capacity of households using their social capital stock, formal safety-nets, markets, infrastructure, communal natural resources and veterinary services. The analysis shows that almost all variables have similar pattern which demonstrates a positive impact on the transformative latent variable.

The multivariate analysis confirmed that half of the households were resilient while the rest were less resilient to undesirable livelihood outcomes. It also demonstrates that gender disparity undermines resilience capacity of households where male headed households become more resilient than their female headed counterparts. The indexing of resilience score to food security scores revealed that almost half of the multidimensionality [mildly] food insecure households are resilient to adverse livelihood outcomes. The result of the analysis further indicates that the resilience capacity of households decreases with increasing HFIAS status. That is the more the food insecure households, the less resilient they become. Similarly, over half of the [mildly and moderately] HFIAS food insecure households have high resilient capacity. The study infers that mildly food insecure households are not necessarily fragile. This implies food security studies without due resilience capacity analysis do not provide the true picture of livelihood condition of households.

7.2. Policy Recommendations

The study has a number of relevant policy ramifications but the following ones need due attention.

I. Land rehabilitation and livelihood asset base building

The aggregate asset endowment analysis revealed that the livelihood asset base in the area is low. This small livelihood asset base indicates that the households are vulnerable to multitude of natural and manmade shock factors and undesirable livelihood outcomes. The aggregate asset analysis calls for extensive and intensive livelihood asset base building and rehabilitation. The disaggregate livelihood asset endowment analysis reveals that human asset and social assets are relatively abundant in the area. Nonetheless, gender inequality, family breakings, illiteracy, poor health, small family size and lack of appropriate agricultural training and demonstration calls for education policy reform, and agricultural extension system improvement. The social asset analysis calls for social asset base enhancement, women empowerment and marriage solidarity.

The financial and natural asset endowments are the least readily available livelihood resources in the area. This low financial asset endowment explicitly calls for the introduction of financial asset package, and tight monitoring and follow up mechanisms. The low natural asset base in the area attributes to the long-term adverse impact of abject poverty and food insecurity, drought, land degradation, farmland encroachment, and protracted civil war. The natural asset analysis calls for the need to sustainable land rehabilitation, water resource development and management, precise farming, livelihood diversification and cash (especially hop) crop plantation and development. The physical asset analysis demonstrates that the households lack access to and control over modern house appliances, modern agricultural productive technologies and tools. They have little access to road networks, secondary and preparatory schools, telecom services, electricity infrastructure, and alternative cooking energy development. The study hence calls for intensive infrastructure development, rural electrification, alternative energy supply and secondary and preparatory school expansion.

II. Land reform and accelerating agricultural production enhancement

The multidimensional food security analysis demonstrates that none of the households in the area are multi-dimensionally food secure. Almost all of the households fall in the verge of multidimensional food insecurity indicators. This complete absence of multi-dimensionally food

secure households in the area calls for broad-based [agricultural] development policy reform, institutional restructuring and public service delivery. It is a must to rethink about and reform the agricultural development strategy, land policy, modern agricultural input supply system; and agricultural technology generation and innovation to transform the smallholder agriculture and revolt the overall economy.

III. Resilience mainstreaming

The multivariate resilience capacity analysis calls for fundamental development policy design shift from analysis of vulnerability of households to negative livelihood outcomes and calculation of resources shortfalls to building their resilience ability to healthily live in shock and stress prone area. Government development policies and plans should close the vulnerability epoch led to humanitarian aid and emergency food aid-night watchman and begin strategic livelihood interventions. Governments and nongovernmental organization must mainstream resilience to their development policies and initiatives in order to build resilience capacity of households to undesirable development outcomes; and protecting them from sliding into such negative outcomes.

7.3. Future Research Areas

The study demonstrated that food security status of households in the area have a strong attachment with the Productive Safety-Net Programme (PSNP) where a small deviation in it can easily enhance their food security condition or drag them down to chronic food insecurity. This study indeed calls for an intensive PSNP impact study on livelihood and food security of households in the area.

Resilience study captures both the static and dynamic capacity of households to undesirable livelihood outcomes. This study lacks suitable panel dataset to fully explore the dynamics of resilience capacity of the households. This study hence followed the direct (descriptive) approach to measure resilience. It tried to measure the current resilience capacity of households to food insecurity at a specific moment in time. It hence recommends to and calls for intensive empirical studies using longitudinal dataset to explore the dynamics of resilience capacity of households over time to undesirable livelihood outcomes. It proposes an indirect measure of resilience tailored to dynamics analysis and, consequently, allows causal inference. Resilience studies require multiple scales and multi-level interactions. This study, in fact, failed to amalgamate the small-scale (household) level resilience capacity analysis with large-scale (national and regional) analysis. We have thus recommended multilevel resilience capacity analysis. These are the major limitation of our resilience study but that does not undermine our first effort to estimate resilience in the area. The finding of study confirmed that there exists gender based resilience capacity disparity. It thus recommends gender disaggregated resilience capacity analysis. There are no well-articulated resilience thresholds in the literature. This study used poorly defined thresholds to determine resilience status of households. Threshold (Cutoff) determination is a tough academic exercise. It demands multidisciplinary professionals. This study calls for an intensive multidisciplinary collaborative study intended to determine resilience thresholds below which households can be easily nominated for development program targeting.

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APPENDICES

Appendix I: Multidimensional food security indicators and dimensions

	Indicator	Code	Indicator Questions (30 days recall period)	Dimensions
1	HFIAS/HHS	NOEAT	How often did you/any HH member have to go a whole day without eating?	Quantity
2	HFIAS/HHS	SLPHUN	How often did you or any HH member go to sleep at night hungry?	Stability
3	HFIAS/HHS	NOFOOD	How often was there ever no food in your HH?	Quantity
4	CSI	SKIPEAT	How often has the HH had to skip entire days without eating?	Quantity
5	CSI	SENDBEG	How often has the HH had to send HH members to beg?	Quantity
6	CSI	SENDEAT	How often has the HH had to send HH members to eat elsewhere?	Quantity
7	FCS/HDDS	PULSE	How often has the household eaten any pulses?	Quality/diversity
8	FCS/HDDS	GRAIN	How often has the household eaten any food made from grain?	Quality/diversity
9	CSI	EATSEED	How often has the HH had to consume seed stock held for next season?	Quantity
10	CSI	WILD	How often has the HH had to gather wild food/ hunt/ immature crops?	Quantity
11	CSI	FDCRED	How often has the HH had to purchase food on credit?	Quantity
12	CSI/rCSI	BORROW	How often has the HH had to borrow food, or rely on help from a relative?	Quantity
13	HFIAS	NOTWNT	How often did you/ HH member have to eat foods you did not want to eat?	Acceptability
14	HFIAS	LIMVAR	How often did you/any HH member have to eat a limited variety of foods?	Quality/diversity
15	HFIAS	PREFER	How often have you unable to eat the kinds of foods you preferred?	Acceptability
16	CSI/rCSI	FWRMEAL	How often has the HH had to reduce the number of meals eaten in a day?	Quantity
17	CSI/rCSI	LMTPORT	How often has the HH had to limit portion size at meal times?	Quantity
18	HFIAS	WORRY	How often did you worry that your HH would not have enough food?	Stability
19	SAFS	SAFS	Self-assessed food security during past 30 days	Stability
20	FCS/HDDS	DAIRY	How often has the household eaten any dairy products?	Quality/diversity
21	FCS/HDDS	EGGS	How often has the household eaten any eggs?	Quality/diversity
22	FCS/HDDS	MEAT	How often has the household eaten any meat, fish?	Quality/diversity
23	FCS/HDDS	FRUIT	How often has the household eaten any fruits?	Quality/diversity
24	FCS/HDDS	VEGET	How often has the household eaten any vegetables?	Quality/diversity

Source: Maxwell et al (2013)

Appendix II: Loading factors (weights) and overall resilience index score values

S/No	Variables	Mean (\bar{X})	Std. Dev. (S)	$\left(\frac{X_j - \bar{X}_j}{S_j}\right)$	Weights (β)	Index Score
1	Annual income	24515.74	16598.28	0.018	0.456	0.008
2	Annual expenditure	12664.81	6077.01	0.053	0.651	0.034
3	Health post distance	2.63	1.92	0.161	0.495	0.08
4	Electricity	67.04	23.73	0.042	0.564	0.024
5	Alternative energy	52.03	32.70	0.036	0.611	0.022
6	School distance	2.24	1.56	0.385	0.511	0.197
7	Road distance	1.67	1.47	0.816	0.527	0.43
8	Total credit	2916.81	4350.11	0.000	0.457	0.000
9	Farmland	198061.4	196259	0.001	0.527	0.000
10	Livestock asset	3.88	2.46	0.144	0.305	0.044
11	Irrigation ratio	0.07	0.14	0.013	0.396	0.005
12	Social safety-net	6697.68	6238.34	0.002	0.644	0.001
13	Social support	1226.59	3392.64	0.000	0.683	0.000
14	Extension training	7.37	4.11	0.485	0.408	0.198
15	Cooperative membership	57.32	17.69	0.960	0.330	0.317
16	Food HHs received from relatives in the area	58.28	18.61	0.822	0.700	0.575
17	Food/seed HHs received from relatives outside the area	56.26	16.57	0.349	0.657	0.23
18	Labor/oxen HHs received from relatives in the area	79.21	24.67	0.032	0.670	0.022
19	Labor/oxen HHs received from nonrelatives outside the area	79.62	24.60	0.976	0.669	0.653
20	Crop loss	1.47	1.71	0.292	0.340	0.099
21	Livestock death	0.09	0.30	0.674	0.748	0.504
22	Medical expense	171.41	718.15	0.011	0.399	0.004
23	Assistance ratio	0.31	0.22	0.012	0.583	0.007
24	Aid stability	69.96	24.52	0.064	0.669	0.043
25	Dependency ratio	0.96	0.84	0.013	-0.604	-0.008
26	Landholding size	0.78	0.37	0.005	0.328	0.002
27	Nonagricultural asset	5533.70	5338.76	0.001	0.626	0.000
28	Agricultural asset	4069.32	6088.82	0.002	0.709	0.001
29	Education	9.88	2.70	0.370	0.448	0.166
30	Labor force	3.47	1.55	0.129	0.548	0.071
31	Number of rooms	2.98	0.98	0.082	0.517	0.042
32	Formal safety-net	69.96	24.52	0.064	0.669	0.043
Resilience Capacity Index						3.815

Appendix III: Questionnaire
Addis Ababa University
College of Development Studies
Data Collection Tool I: Questionnaire

PhD Research Project on Resilience of Households to Food Insecurity in Ahferom Wereda,
Central Zone of Tigray National Regional State, Ethiopia

Dear interviewee; Gebrerfael Girmay is a PhD student at Addis Ababa University, College of Development Studies. He is now conducting a research project on “Resilience of Households to Food Insecurity” in our Wereda to complete his study. This project intends to analyze multidimensional food security status of randomly selected households in our wereda and estimate their resilience capacity to food insecurity. The purpose of this survey is thus to collect information from randomly selected households in our Wereda. The information you provide him will be confidential and will not be used by government tax authorities or any other nongovernmental organizations to assess the need for food aid or other assistance. It will be used for research purpose only. The researcher (or interviewer) is therefore kindly asking you to provide him genuine information and honest answers to each question in this questionnaire. The researcher thanks you in advance for your kind cooperation.

General Instruction for Interviewers/enumerators

- Tell the purpose of the study and introduce yourself before starting the interview
- Please encircle, put (X) or the code chosen by the respondent whenever appropriate in the space provided for all close-ended questions
- When the respondent chooses more than one response for some questions, rank them based on the preference of the respondent
- Skip the question (or code) when an interviewee is not required to answer that question because of not being relevant to that interviewee
- Write down the response for open-ended questions whenever the respondent provides more detail

Date of the Interview: _____; Name of Enumerator: _____ Signature: _____

1. Demographic Characteristics of the Households

- 1.1. Name of the household head: _____; Household ID No. _____
- 1.2. Kebele: _____ Village: _____
- 1.3. Agro-ecology: 1. Highland 2. Midland 3. Lowland
- 1.4. Sex of the household head: 1. Male 2. Female
- 1.5. Position of the respondent in the household: 1. Household head 2. Spouse 3. Son/daughter 4. Relative
- 1.6. Age of the household head (in years) _____ (years)
- 1.7. Main occupations of the household: 1=Unemployed, 2=Subsistence farmer, 3=Artisan/skilled tradesman/woman, 4=Petty trade, 5=Formal employment; 6= others (specify) _____
- 1.8. Marital status of the head: 1. Single 2. Married 3. Divorced 4. Widowed
- 1.9. Are you literate? 1= yes 2= No
- 1.10. If literate, years of formal education: _____
- 1.11. Family size: Male _____ Female _____ Total: _____
- 1.12. Number of dependent household members: Children (below 15 years): _____ Adults (above 64) _____
- 1.13. PSNP membership: 1. Member on food for work 2. Member on free access to food 3. Nonmember 4. Others (specify) _____

2. Livelihood activities and strategies

Livelihood activities		Sources of household income/food (Tick)	Rank based on their importance to your income/food	Seasonal availability 1=Dry season 2=Wet season 3=both
1	Farming (crop and livestock production)			
2	Casual labor			
3	Firewood or charcoal sales			
4	Employment (salary)			
5	Private business (trade)			
6	Pension			
7	Aid and transfer			
8	Remittance			
9	Gifts/inheritance			
10	Other (specify)			

3. Crops, vegetables and fruits production

Crops, vegetables and fruits	Area planted (ha) in 2008 E.C	Variety	Seed source	Total yield (Kg)			Price/Kg (in Birr)
				Consumed immediately	Sold	Stored	
Sorghum							
Wheat							
Millet							
Teff							
Barely							
Maize							
Peas							
Beans							
Tomato							
Potato							
Pepper							
Carrot							
Garlic							
Onion							
Others (specify)							

4. Household Assets

4.1. Household Incomes (in Birr)

Did you or any of your household members receive cash income from any of the following sources of income within the last year?								
Farm income Sources		Income (in Birr)	Nonfarm income sources		Income (in Birr)	Nonfarm income sources		Income (in Birr)
1	Cereal crops		16	Salary		31	Traditional healer	
2	Vegetables		17	Wage labor		32	Grain trading	
3	Fruits		18	Gesho trading		33	Livestock and livestock products trading	
4	Oilseeds		19	Cash transfers (PSNP)		34	Petty trading	
5	Leasing out crop land		20	Military Service		35	Market brokering	
6	Cattle sale		21	Pension		36	Baskets or mats making and selling	
7	Goat and sheep		22	Firewood or charcoal selling		37	Spinning or weaving	
8	Donkey, mule and horse		23	Animal feed (grass or fodder)		38	Utensils making and selling	
9	Poultry and poultry products		24	construction materials		39	Farm tools selling	
10	Milk and milk products		25	Wild fruits (cactus)		40	Pottery making	
11	Animal skins and hides		26	Embroidery and tailoring clothes		41	Metalwork	
12	Bee colonies or beehives		27	Blacksmithing		42	Furniture (wood work)	
13	Honey and wax		28	Carpentry		43	Begging	
14	Gesho (hop)		29	Barber or hairdresser		44	Remittance	
15	Others (specify)		30	Musician (Singer and Dancer)		45	House rent/sell	
						45	Others: (Specify: _____)	

4.2. Food and Nonfood Expenditure (in Birr)

Please indicate the monthly expenditure of your household in the following items

Did you or anyone in your household buy any one of the following items?						
Food expenditure (in the last one month)		Expense (in Birr)	Nonfood expenditure (in the last one year)			Expense (in Birr)
1	Sorghum		34	Firewood and charcoal		
2	Wheat		35	Energy (fuel, solar or electricity)		
3	Millet		36	Paraffin or kerosene		
4	Barley		37	Candles and matches		
5	Teff		38	Transport		
6	Injera		39	Milling fees for grains		

7	Bread		40	Donation (church, charity or beggars)	
8	Biscuits and scones		41	Personal hygiene products	
9	Pasta and Macaroni		42	Household utensils	
10	Sweet potato		43	Rent (house, oxen and land)	
11	Irish potato		44	Maintenance (house, radios, watches, spare parts)	
12	Chick peas		45	Batteries	
13	Horse beans		46	Household furniture	
14	Onion and garlic		47	Clothes (for children, husband, and wife)	
15	Tomato		48	Linen-towels, sheets, blankets	
16	Green pepper		49	Shoes	
17	Meat		50	Umbrella	
18	Milk and milk products		51	Gold, dowry for spouse (ceremonial expenses)	
19	Eggs		52	Traditional medicine and healers	
20	Cactus fruit		53	Modern medical treatment and medicines	
21	Banana		54	Educational expenses (books, pens, pencils, uniform)	
22	Papaya and orange		55	Agricultural inputs expenditure	
23	Sugar and coffee		56	Rituals (religious and public) ceremony	
24	Edible oil		57	Marriage ceremony	
25	Honey		58	Mirage and funeral contribution	
26	Tea/coffee		59	Construction materials (bricks, cement, wood)	
27	Soft drinks		60	Farm tools	
28	Fruit juice		61	Government taxes and levies	
29	Local liquor (Tella)		62	Punitive Compensation and/or penalties	
30	Salt/pepper		63	Other expenses (specify)	
31	Alcoholic beverages (beer)		64		
32	Meal eaten at restaurant		65		
33	Others (specify)				

4.3. Saving and Credit Services

1	Do you have access to saving and credit institutions?	1. Yes 2. No
2	If yes, have you or any household members taken out a loan in the last year (cash or in-kind)?	1. Yes 2. No
3	If no, why not?	1. Did not need 2. Could not find a loan that met my needs 3. Afraid I couldn't pay back 4. No loan providers in my area 5. Other (specify) _____
4	If yes, where did you or any of your household members take the loans from?	1. Money lender 2. Friend/neighbor 3. Micro credit 4. Bank 5. Iqub or Eder 6. Input supplier 7. Local trader 8. Other (specify) _____
5	What was the total value of the loan in the last five years? (Birr)	_____ Birr
6	Do you have to pay a monthly interest rate or service fee on the loan?	1. Yes 2. No 3. DK
7	If yes, what is the monthly interest rate on the loan?	_____%
8	What is the service fee on the loan?	_____%

9	What amount have you paid back to date? (Birr)	_____ Birr
10	Purposes of the loans	<ol style="list-style-type: none"> 1. To feed family 2. Pay school fees 3. Pay medical fees 4. Production inputs 5. Business capital 6. Pay veterinary fees 7. Others
11	Do you or anyone in your household have cash saving?	<ol style="list-style-type: none"> 1. Yes 2. No 3. DK
12	If yes, where is the savings held?	<ol style="list-style-type: none"> 1. In cash at home 2. With MFI 3. With Bank 4. With Savings group 5. Other (specify) _____
13	How much money have you or anyone of your household members saved in the last year?	_____ (Birr)
14	What is the primary purpose of the saving?	<ol style="list-style-type: none"> 1. To use in emergencies 2. To buy livestock 3. For non-livestock business investment 4. Other (specify)

4.4. Physical Assets

How many of the following physical assets do you and your household own?							
Consumption Assets		Quantity	Estimated value	S/No	Productive assets	Quantity	Estimated value
1	Charcoal/wood stove			1	Plough yoke		
2	Kerosene stove			2	Plough beam		
3	Sofa			3	Plough lever		
4	Leather bed			4	Pair of plough blade		
5	Wooden bed			5	Metal-Plough		
6	Metal bed			6	Sickle		
7	Cell phone			7	Axe		
8	Radio			8	Pruning shears		
9	Tape player			9	Hoe		
10	Television			10	Spade or shovel		
11	Jewelry, gold			11	Traditional beehive		
12	Jewelry, silver			12	Modern Beehive		
13	Firearms			13	Chemical sprayer		
14	Modern Chair			14	Mechanical water pump		
15	Modern Table			15	Motorized water pump		
16	Wheelbarrow			16	Stone mill		
17	Bicycle			17	Access to grain mill		
18	Cart (animal drawn)			18	Small tractor		
19	Passenger car			19	Motorized tiller		
20	Generator			20	Others (specify)		
21	Solar lamp			21	Others (specify)		
22	Solar/hydro energy			22	Others (specify)		
Livestock assets		Number	Estimated value	S/No	Livestock assets	Number	Estimated value
1	Local Cows			8	Exotic/crossbred calves		
2	Exotic/crossbred cows			9	Goats		
3	Oxen			10	Sheep		

4	Bulls			11	Donkeys		
5	Local heifers			12	Mules		
6	Exotic/crossbred heifers			13	Horses		
7	Local Calves			14	Poultry		
8	Others			15	Others		
Housing Characteristics							
1	Type of dwelling	1= Corrugated sheet roofed; 2 Thatched roofed; 3=Other (specify)					
2	Materials used to construct the roof of the house	1=Corrugated iron; 2= Cement; 3=Thatch; 3=Wood and mud; 4=Plastic sheeting 5= Other (specify)					
3	Number of rooms in the house	_____ rooms					
4	Latrine type	1. Has no toilet 2. Flush toilet , private 3. Flush toilet, shared 4. Pit, private 5. Pit, shared 6. None of the above					

4.5. Human Capital and Labor Migration

Please indicate the human asset endowment of your household		
S/No	Indicator	Response Options
1	Is there any shortage of labor in your family?	1. Yes 2. No
2	If yes, what is the cause for this labor shortage?	1. Family size 2. Migration 3. Family health problems 4. Others (specify)
3	Have you or anyone in your household ever received any vocational (job) or skill training?	1. Yes 2. No
4	Who provided the vocational skills training?	1. Government 2. NGO 3. Private sector 4. Others (specify)
5	Have you or anyone in your household ever received any business development training?	1. Yes 2. No
6	Who provided the business development training?	1. Government 2. NGO 3. Private sector 4. Others (specify)
7	Have you or anyone in your household ever received any early warning training?	1. Yes 2. No
8	Who provided the early warning training?	1. Government 2. NGO 3. Private sector 4. Others (specify)
9	Have you or anyone in your household ever received adult education (literacy or numeracy or financial education)?	1. Yes 2. No
10	Who provided the adult education (literacy or numeracy or financial education)?	1. Government 2. NGO 3. Private sector 4. Others (specify)
11	Have you or anyone in your household ever received any natural resource management training?	1. Yes 2. No

12	Who provided the natural resource management training?	1. Government 2. NGO 3. Private sector 4. Others (specify)
13	Have you or anyone in your household ever received training on postharvest handling?	1. Yes 2. No
14	Who delivered the postharvest handling training?	1. Government 2. NGO 3. Private sector 4. Others (specify)
15	Have you or anyone in your household ever received training in how to use your cell phone to get market information like prices?	1. Yes 2. No
16	Who did you deliver the training on how to use your cell phone to get market information like prices from?	1. Government 2. NGO 3. Private sector 4. Others (specify)
17	Is anybody in your family chronically ill?	1. Yes 2. No
18	What is the current health status of you and your household members?	0. Poor 1. Medium 2. Good
19	Has anyone in your family been so sick in the past one year that they had to miss work or school?	1. Yes 2. No
20	Has anyone in your family suffered from TB, Malaria, Cholera or other communicable diseases in the past six months?	1. Yes 2. No emigrant
21	Has anyone in your HH died due to illness or natural disasters (drought, floods, landslides, malnutrition) in the past 5 years?	1. Yes 2. No
22	Has anyone in your HH been injured due to the climate related disasters (drought, flood, epidemics etc...)	1. Yes 2. No
23	Have you or anyone in your household ever migrated?	3. Yes 4. No
24	If yes, who frequently migrates from your family?	1. Husband 2. Wife 3. Children
25	How long has your household been living in this location?	_____ years
26	If you have been here for two years or less, where were you before?	1. Urban 2. Rural 3. Peri-urban 4. Abroad
27	Do you have current plans to move location of your household?	1. Yes 2. No
28	If yes, where are you planning to move?	1. Urban 2. Rural 3. Peri-urban 4. Abroad
29	Has anyone who was living in your household migrated in the past five years?	1. Yes 2. No
30	If yes, where did s/he migrate to?	1. Urban 2. Rural 3. Peri-urban 4. Abroad
31	What is the main reason/s for his/her migration?	1. Education

		2. Search for alternative source of income 3. Marriage 4. Conflict 5. Cultural difficulties 6. Others (specify)
32	How long ago did the person migrate?	_____ years
33	Did the person ever send back money to your family?	1. Yes 2. No
34	Did the person ever return?	1. Yes 2. No

4.6. Natural Asset endowment

How many of the following natural assets do you and your household own?		
	Questions	Response options
1	Do you have farm land?	1. Yes 2. No
2	Own land holding size	_____ hectares
3	Land rented in	_____ hectares
4	Land rented out	_____ hectares
5	Land shared with communal	_____ hectares
6	Total agricultural land holding size	_____ hectares
7	Total nonagricultural land holding size	_____ hectares
8	How do you perceive the fertility status of your land (soil) relative to other farmers?	1. Good 2. Fair 3. Poor
9	Mode of land tenure acquisition	_____
10	Do you feel your farm is naturally conducive for agricultural production?	1. Yes 2. No
11	What are the methods used to plough your land?	1. drought oxen 2. Labor 3. Farm implements 4. Farm machineries
12	Do you practice irrigation?	1. Yes 2. No
13	If yes, indicate your total irrigated land	_____ hectares
14	Main source of the irrigation water?	1. River 2. Pond 3. Spring 4. Wells 5. Others (specify)
15	Do you have access to agriculture extension services for crops?	1. Yes 2. No
16	If yes, how many times did development agents visit you in the last cropping season?	_____ times/month
17	Did you cultivate any crops or fruits in the last planting season?	1. Yes 2. No
18	If yes, specify the total land cultivated in the last season.	_____ hectares
19	Total land cultivated with staple food crop in the last crop season	_____ hectares
20	Did you apply chemical fertilizer in the last cropping season?	1. Yes

		2. No
21	If yes, specify the amount. Urea Dap	_____ Kg _____ Kg
22	Total crop land size (staple food crop and other crops) fertilized by organic manure in the last season	_____
23	How much pesticides have you applied last year on all crops?	_____ liters
24	How much herbicides have you applied last year on all crops?	_____ liters
25	Land not cultivated in the last season	_____

4.7. Social Asset endowment

S/No	Questions	Response Options
1	Are you or anyone in your household a member of any formal or informal organization in your locality?	1. Yes 2. No
2	If yes, tell me the first three most important formal or informal organizations to your household?	1. _____ 2. _____ 3. _____
3	Do you or anyone in your household trust most people in your community?	1. Yes 2. No
4	To what extent do you trust local government officials?	1. Very great extent 2. Great extent 3. neutral 4. Small extent 5. Very small extent 6. No knowledge
5	To what extent do you trust regional state officials?	1. Very great extent 2. Great extent 3. Neutral 4. Small extent 5. Very small extent
6	Did you or any one in your household participate in any communal activities in the past 12 months?	1. Yes 2. No
7	If yes, how many times did you or anyone in your household participate in the past 12 months?	_____ times/year
8	To what extent does difference in wealth, income and social status characterize your village/neighborhood?	a. To a very great extent b. To a great extent c. Neutral d. To a small extent e. To a very small extent
9	Has your household received any kind of support from government or NGO in the last year?	3. Yes 4. No
10	What types of support did you receive from government or NGO during the last year?	1. Food ration 2. Food/cash for-work 3. Housing materials 4. Installed water points 5. Install latrine 6. School for children 7. Cash transfer 8. Other (specify)
11	Has your household received any kind of support from relatives, neighbors or friends in the past 12 months?	3. Yes 4. No
12	What types of assistance has your household received from relatives, neighbors or friends in the past 12 months?	1. Remittances 2. Gifts/donation of cash 3. Loans (cash, seeds) 4. Other (specify)
13	Did you or anyone in your household receive money/food support	1. Yes

	from your relatives living here or elsewhere?	2. No
14	Did you or anyone in your household receive money/food support from your neighbors or people who are not your relatives?	1. Yes 2. No
15	If you or anyone in your household was ill or injured and needed help with work, would you able to receive it from your relatives living here or outside?	1. Yes 2. No
16	If you or anyone in your household was ill or injured and needed help with work, would you able to receive it from your neighbors?	1. Yes 2. No
17	Has your household given assistance to relatives, neighbors or friends in the past 12 months?	1. Yes 2. No
18	What types of assistance has your household given to relatives, neighbors or friends in the past 12 months?	1. Remittances 2. Gifts/donation 3. Loans (cash, seeds) 4. Other (specify)
19	If your relative had a problem and needed money/ food urgently, would you be able to give money or food?	1. Yes 2. No
20	If your neighbor had a problem and needed money/food/labor urgently, would you be able to give money or food?	1. Yes 2. No
21	How safe from crime and violence do you feel when you are alone at home?	a. Very safe b. Moderately safe c. Neutral d. Moderately unsafe e. Very unsafe
22	In general, how happy do you and your household consider to be?	a. Very happy b. Moderately happy c. Neither happy nor unhappy d. Moderately unhappy e. Very unhappy
23	Do you feel that your household has the power to make important decisions that change the course of your life?	a. Totally unable to change life b. Mostly unable to change life c. Neither able nor unable d. Mostly able to change life e. Totally able to change life
24	How often have people in this village jointly petitioned government officials or political leaders for something benefiting the community in the past 12 months?	a. Never b. Once c. A few times (<5) d. Many times (>5)
25	Did you vote on the last local/regional/national election?	1. Yes 2. No
26	If not, why did not you vote?	_____

4.8. Access to Information

Types of information	Did you receive any information on (topics) last year?										
			Main sources of information								
	Yes	No	DAs	Neighbors/ Friends	Model Farmers	Government Officials	Family members	Newspaper	Radio /TV	Internet or SMS	
Weather patterns											
Rainfall prospects											
Animal health/ husbandry											
Livestock disease and epidemics											
Market (price) information											
Business and											

investment opportunities										
Saving and credit opportunities										
Agricultural technologies and inputs										

4.9. Access to Market

1	How often do you go to the market in one month?	_____ days
2	Distance to market center (in Kilometers)	_____ kilometers
3	Where do you normally sell your livestock and animal products? (Identify the most frequently used location for these sales)?	<ol style="list-style-type: none"> 1. This village 2. Local market town 3. Woreda town 4. Zonal town 5. Other (specify)
4	Why do you sell at this location?	<ol style="list-style-type: none"> 1. Get best price at this market 2. Do not have access to transport to other markets 3. Poor road conditions to other markets 4. Not aware of prices at other markets 5. Other (specify)
5	Are there other markets where you would prefer to sell your livestock/animal products?	<ol style="list-style-type: none"> 1. Yes 2. No 3. DK
6	If yes, why do you not sell at these markets?	<ol style="list-style-type: none"> 1. Transport cost too high 2. Too long to reach the market 3. Unsure of prices in that market 4. No place or too costly to stay/keep animals at that place 5. Poor transport conditions 6. Security reasons 7. Other (specify)
7	Where do you normally sell your agricultural crops?	<ol style="list-style-type: none"> 1. At farm 2. In village 3. Local market 4. Regional market 5. Other (specify)
8	Why do you sell at this location?	<ol style="list-style-type: none"> 1. Get best price at this market 2. Do not have access to transport to other markets 3. Poor road conditions to other markets 4. Not aware of prices at other markets 5. Other (specify)
9	Are there other markets where you would prefer to sell your agricultural crops?	<ol style="list-style-type: none"> 1. Yes 2. No 3. DK
10	If so, why do you not sell at these markets?	<ol style="list-style-type: none"> 1. Transport cost too high 2. Too long to reach the market 3. Unsure of prices in that market 4. No place to keep crops at that place 5. Poor transport conditions 6. Security reasons 7. Other (specify)
11	Do you purchase agricultural and livestock inputs?	<ol style="list-style-type: none"> 1. Yes 2. No 3. DK

12	Where do you normally purchase your main agricultural and livestock inputs?	<ol style="list-style-type: none"> 1. At farm 2. Village shop 3. Local market 4. Regional market 5. Other (specify)
13	Why do you purchase inputs at this location?	<ol style="list-style-type: none"> 1. Get best price at this market 2. Do not have access to transport to other markets 3. Poor road conditions to other markets 4. Not aware of prices at other markets 5. Other (specify)
14	Are there other markets where you prefer to purchase agricultural and livestock inputs?	<ol style="list-style-type: none"> 1. Yes 2. No 3. DK
15	If so, why do you not purchase at these markets?	<ol style="list-style-type: none"> 1. Transport cost too high 2. Too long to reach the market 3. Unsure of prices in that market 4. No place to keep crops at that place 5. Poor transport conditions 6. Other (specify)

4.10. Household Access to Basic Services

S/No.	Indicators	Response Options
1	Does your household have access to piped water?	<ol style="list-style-type: none"> 1. Yes 2. No
2	If yes, is the water in public standpipes or piped into your house?	<ol style="list-style-type: none"> 1. Public standpipe 2. Piped into houses
3	Main sources of drinking water in the dry season	<ol style="list-style-type: none"> 1. Tube wells or Boreholes 2. Protected Hand-dug wells 3. Protected springs 4. Rainwater collection 5. Ponds/rivers 6. Unprotected springs/wells 7. Other (specify)
4	Main sources of drinking water in the wet season	<ol style="list-style-type: none"> 1. Tube wells or boreholes 2. Protected hand-dug wells 3. Protected springs 4. Rainwater collection 5. Ponds/rivers 6. Unprotected spring 7. Other (specify)
5	How much time does it take you or anyone in your household to fetch water (round trip)	_____ (Minutes)
6	Source of energy utilization	<ol style="list-style-type: none"> 1. Animal dung 2. Charcoal 3. Kerosene 4. Electricity 5. Others (specify)
7	Does your household have access to electricity services?	<ol style="list-style-type: none"> 1. Yes 2. No
8	What is the main source of electricity?	<ol style="list-style-type: none"> 1. Public utility 2. Generator 3. Other (specify)
9	Do you or anyone in your household have cell phone service?	<ol style="list-style-type: none"> 1. Yes

		2. No
10	Is there a public telephone service in your area?	
11	How far is the nearest public telephone to your house? (km)	_____ Kilometers
12	Main routes used to reach your household? (multiple responses possible) 0914732797	1. Paved road 2. Direct road 3. Mixed paved and dirt 4. Footpath 5. Other (specify)
13	Is your household served by a public transport system?	1. Yes 2. No
14	How far is your household from the main road (Km)	_____ Kilometers
15	Is there a primary school in this community?	1. Yes 2. No
16	How far away is the nearest primary school from your house?	_____ Kilometers
17	How many of your eligible school-age children attend primary school?	_____
18	Are there enough teachers for the primary school that your children attend?	1. Yes 2. No
20	What is the physical condition of the primary school that your children attend?	1. Very good 2. Good 3. Poor 4. Very poor
21	Is there a secondary school in your community?	1. Yes 2. No
22	How far away is the nearest secondary school from your house?	_____ Kilometers
23	What share of eligible school-age children attends secondary school?	1. All 2. Most 3. About half 4. Less than half 5. Very few
24	Are there enough teachers for the secondary school that children in your community attend?	1. Yes 2. No
25	What is the physical condition of the secondary school that the children in this community attend?	1. Very good 2. Good 3. Poor 4. Very poor
26	Is there a health center in your community?	1. Yes 2. No
27	How far is the nearest health center from your house? (km)	_____ Kilometers
28	What is the physical condition of the nearest health center to your house?	1. Very good 2. Good 3. Poor 4. Very poor
29	Did you or anyone in your household get health services from the health center last year?	1. Yes 2. No
30	If no, why you or anyone in your household did not get health services from the health center? (multiple responses possible)	1. No beds 2. Shortage staff in the health center 3. No transportation 4. No/poor road condition 5. No drugs at the health center 6. No money for services 7. Other (specify)
31	Do you have access to veterinary services in your community?	8.
32	How far is the veterinary center from your house? (km)	_____ Kilometers
33	What is the physical condition of the nearest veterinary center to	1. Very good

	your house?	<ol style="list-style-type: none"> 2. Good 3. Poor 4. Very poor
34	Did you or your household receive veterinary services from the veterinary center last year?	<ol style="list-style-type: none"> 1. Yes 2. No
35	Is no, why did not you get veterinary services from the veterinary center? (multiple responses possible)	<ol style="list-style-type: none"> 1. No staff in the center 2. No transportation 3. No/ poor road condition 4. No equipment/drugs at the veterinary center 5. No money for service 6. Other (specify)
36	Which services are provided by the veterinary center? (multiple responses possible)	<ol style="list-style-type: none"> 1. Livestock vaccinations 2. Livestock antibiotics 3. De-worming 4. Dipping inoculation 5. Supplemental feeding 6. Others (specify)
37	How far is the nearest abattoir from your house? (km)	_____ kilometers
38	Are there agricultural extension services offered in this area?	<ol style="list-style-type: none"> 1. Yes 2. No
39	Did you or anyone in your household get agricultural extension services in the past cropping season?	<ol style="list-style-type: none"> 1. Yes 2. No
40	Is no, why did not you get agricultural extension services? (multiple responses possible)	<ol style="list-style-type: none"> 1. No extension worker 2. Distance 3. No transportation 4. No/poor road condition 5. No money for services 6. Other (specify)
41	Which services are provided by the agricultural extension service? (multiple responses possible)	<ol style="list-style-type: none"> 1. Seed supply 2. Fertilizer supply 3. Training 4. Others (specify)
42	Are there training (adult education) institutions or centers in your community?	<ol style="list-style-type: none"> 1. Yes 2. No
43	If yes, who provides these services? (multiple responses possible)	<ol style="list-style-type: none"> 1. Government 2. NGOs 3. Religious organization 4. Other (specify)
44	Are there institutions that can provide you food assistance in time of emergency?	<ol style="list-style-type: none"> 1. Yes 2. No
45	If yes, who provides these services? (multiple responses possible)	<ol style="list-style-type: none"> 1. Government 2. NGOs 3. PSNP

5. Household Food Insecurity Access Scale (HFIAS)

1. Rarely means once or twice in the past four weeks
2. Sometimes means three to ten times in the past four weeks
3. Often means more than ten times in the past four weeks

/No.	Questions	Response Options	Code
1	In the past four weeks, did you worry that your household would not have enough food?	0. No 1. Yes	
1.1.	How often did this happen?	2. Rarely 3. Sometimes 4. Often	
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 1. Yes	
2.a	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 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 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 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 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 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 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	

6. Multidimensional Food Security Indicator questionnaire

	Indicator	Name	Question	Response options			
				Often	Sometimes	Rarely	Never
1	HFIAS/HHS	NOEAT	In the past 30 days, how often did you or any HH member have to go a whole day without eating?				
2	HFIAS/HHS	SLPHUN	In the past 30 days, how often did you or any HH member go to sleep at night hungry?				
3	HFIAS/HHS	NOFOOD	In the past 30 days, how often was there ever no food in your HH?				
4	CSI	SKIPEAT	In the past month, how often has the HH had to skip entire days without eating?				
5	CSI	SENDBEG	In the past month, how often has the HH had to send HH members to beg?				
6	CSI	SENDEAT	In the past month, how often has the HH had to send HH members to eat elsewhere?				
7	FCS/HDDS	PULSE	In the past month, how often has the household eaten any pulses?				
8	FCS/HDDS	GRAIN	In the past month, how often has the household eaten any food made from grain?				
9	CSI	EATSEED	In the past month, how often has the HH had to consume seed stock held for next season?				
10	CSI	WILD	In the past month, how often has the HH had to gather wild food, hunt, or harvest immature crops?				
11	CSI	FDCRED	In the past month, how often has the HH had to purchase food on credit?				
12	CSI/rCSI	BORROW	In the past month, how often has the HH had to borrow food, or rely on help from a relative?				
13	HFIAS	NOTWNT	In the past 30 days, how often did you or any HH member have to eat foods you did not want to eat?				
14	HFIAS	LIMVAR	In the past 30 days, how often did you or any HH member have to eat a limited variety of foods?				
15	HFIAS	PREFER	In the past 30 days, how often were you or any HH member not able to eat the kinds of foods you preferred?				
16	CSI/rCSI	FWRMEAL	In the past month, how often has the HH had to reduce the number of meals eaten in a day?				
17	CSI/rCSI	LMTPORT	In the past month, how often has the HH had to limit portion size at meal times?				
18	HFIAS	WORRY	In the past 30 days, how often did you worry that your HH would not have enough food?				
19	SAFS	SAFS	Self-assessed food security during past 30 days				
20	FCS/HDDS	DAIRY	In the past month, how often has the household eaten any dairy products?				
21	FCS/HDDS	EGGS	In the past month, how often has the household eaten any eggs?				
22	FCS/HDDS	MEAT	In the past month, how often has the household eaten any meat, fish?				
23	FCS/HDDS	FRUIT	In the past month, how often has the household eaten any fruits?				
24	FCS/HDDS	VEGET	In the past month, how often has the household eaten any vegetables?				

7. Exposure of Households to Shocks

S/No	Questions	Response options
1	Have you experienced any form of shocks in the previous five years?	<ol style="list-style-type: none"> 1. Yes 2. No
2	If yes, what were the most commonly occurring shocks?	<ol style="list-style-type: none"> 1. Drought 2. Flood 3. Crop/livestock diseases 4. Crop failure 5. Conflict shocks 6. Theft of money/asset 7. Landslides/erosion 8. Food price inflation 9. Agricultural input inflation 10. Agricultural products deflation 11. Household member death 12. Other specific
3	How many times did you experience to such shocks in the last five years?	_____ times
4	How do you rate your extent of vulnerability to such shocks?	<ol style="list-style-type: none"> 1. Low 2. Medium 3. High
5	If you have been highly vulnerable to such shocks, what are the possible reasons?	<ol style="list-style-type: none"> 1. Lack of early warning information 2. Lack of resources for timely action 3. Limited livelihood assets 4. Others specify
6	Is there any early warning system or practice in your locality?	<ol style="list-style-type: none"> 1. Yes 2. No
7	If there are EWS, what kind of early warning institutions/structures are there?	<ol style="list-style-type: none"> 1. Formal/government 2. Informal/traditional
8	How often have you been informed about the potential risk of natural disasters (erratic rain fall, flooding, land slid, outbreak of crop pests and diseases)	<ol style="list-style-type: none"> 1. Frequently 2. Occasionally/seasonally 3. Rarely
9	How severe was the impact on your income and food consumption?	<ol style="list-style-type: none"> 1. None 2. Slight impact 3. Moderate impact 4. Strong impact 5. Worst ever happened
10	Who provides the information on early warning?	<ol style="list-style-type: none"> 1. Government 2. NGOs 3. Others (specify)
11	How do you rate the contribution of the early warning system for you to withstand from the shocks?	<ol style="list-style-type: none"> 1. High 2. Medium 3. Low 4. Not at all
12	What are your main early warning information needs?	<ol style="list-style-type: none"> 1. Information on rainfall 2. Market information 3. About impending possible hazard 4. Others (specify)

13	How do you generally rate relevance of the EW information being disseminated by the current EW&DRR system?	<ol style="list-style-type: none"> 1. Very relevant 2. relevant 3. less relevant 4. irrelevant
14	Which mechanisms are being used to disseminate EW information?	<ol style="list-style-type: none"> 1. Radio and TV 2. Printing media 3. Community meetings 4. Through <i>Kebele</i> EW committees 5. Command post 6. Others (specify)
15	How severe was the impact on your income and food consumption?	<ol style="list-style-type: none"> 1=None 2= Slight impact 3=Moderate impact 4=Strong impact 5=Worst ever happened
15	To what extent were you and your household able to recover?	<ol style="list-style-type: none"> 1. Did not recover 2. Recovered some, but worse off than before 3. Recovered to same level as before 4. Recovered and better off 5. Not affected
16	If you recovered, how did you cope with the shock?	<ol style="list-style-type: none"> i. Spent cash savings ii. Sold assets iii. Sold livestock iv. Started a new business v. Removed children from school to work vi. Sent children to live with relative vii. Received aid viii. Reduced food consumption ix. Borrowed money x. Other (specify)
17		

8. Coping Strategies

Has your household faced longer term food shortages in the last twelve months? 1. Yes 2. No If yes, please indicate how you tried to cope with the food shortage?					
S/No	Coping Strategies	Frequencies (Tick)			
		Often	Sometimes	Rarely	Never
1	Rely on less preferred and less expensive foods				
2	Sell livestock to buy food/grain				
3	Purchase food on credit				
4	Depend on wild fruits and roots				
5	Consume seed stock held for next season				
6	Receive food/grain/money from neighbors/relatives/friends				
7	Firewood and charcoal selling				
8	Seasonal migration (wage labor)				
9	Receive food aid from government and NGOs				
10	Withdrawal of money from savings				
11	Remittance				
12	Permanent migration				
13	Send children or an adult to eat with relatives and neighbors				
14	Sell household assets (e.g., radio, bed)				
15	Rent or sell productive assets (Water pump, Beehives)				
16	Dropping of children out of school and send them to work for money (e.g., domestic service)				
17	Participate in food-for-work or cash-for-work				
18	Take out a loan from friends or relatives				
19	Take out a loan from a money lender				
20	Borrowing money from MFIs and Banks				
21	Limit portion/size of meals				
22	Reduce number of meals per day				
23	Restrict food consumption of adults				
24	Skip entire days without eating				
25	Others (specify)				

PhD Research Project on Resilience of Rural Households to Food
Insecurity in Ahferom Wereda, Central Zone of Tigray National
Regional State, Ethiopia
By Gebrerufael Girmay

Data Collection Tool II: Focus Group Discussion Guideline

- ✓ Characteristic features of the community
- ✓ Asset holding capacity
- ✓ Access to infrastructure and basic social services
 - Access to potable water
 - Education (primary and secondary schools)
 - Electricity
 - Road networks
 - Health post/extension
 - Public telephone
 - Veterinary medicine services
 - Agricultural extension services
 - Saving and credit institutions
- ✓ Market access
- ✓ Access to information
- ✓ Land tenure system (transfer of land)
- ✓ Exposure to shock in the last five years
 - Natural shocks
 - Economic shocks
 - Sociopolitical shocks (conflicts)
 - Crop and animal diseases
- ✓ Local and household level food shortage coping strategies

Data Collection Tool III: Key Informant Interview Guideline

- ✓ Water resources (irrigation) development (alternative agricultural water supply)
- ✓ Community organizations (formal and informal institutions)
- ✓ Government policies and programs (Quantity, Quality and Equity)
- ✓ NGO programs (Type, Quantity, Quality and Equity)
- ✓ Private sector involvement
- ✓ Natural and manmade shock trends and intensity in the last five years
 - Natural shocks
 - Economic shocks
 - Sociopolitical shocks (conflicts)
 - Crop and animal diseases
- ✓ Institutional and technological constraints and opportunities in the Wereda
- ✓ Early warning systems and practices
- ✓ Regional and local disaster prevention and preparedness
- ✓ Food security situation and Productive Safety Net Programs (quantity and equity)
- ✓ Food shortage coping strategies (local)