COLLEGE OF DEVELOPMENT STUDIES
CENTER FOR FOOD SECURITY STUDIES

DETERMINANTS OF INCOME DIVERSIFICATION AND ITS IMPLICATION ON RURAL HOUSEHOLDS FOOD SECURITY IN GUBALAF TO WOREDA, NORTHERN ETHIOPIA

BY

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ADDIS ABABA, ETHIOPIA

JULLY 2019

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A THESIS SUBMITTED TO CENTER FOR FOOD SECURITY STUDIES COLLEGE OF DEVELOPMENT STUDIES ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENTS OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN FOOD SECURITY AND DEVELOPMENT STDUIES

ADDIS ABABA, ETHIOPIA

JULLY 2019

ADDIS ABABA UNIVERSITY
COLLEGE OF DEVELOPMENT STUDIES
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Declaration

This thesis is my original work and has not been presented for MSc degree in any other University and that all the sources and materials used for the thesis have been properly acknowledged.

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As supervisors/co-advisers of the thesis, we certify that we have read and evaluated the thesis proposal prepared by **Milkyas Assmamaw** entitled '*Determinants of Income Diversification and Its Implication to Rural Households Food Security in Gubalafto Woreda, Northern Ethiopia*' and recommend for Open Defense as fulfilling the requirement for the degree of **Master of Science in Food Security and Development Studies.**

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ACKNOWLEDGEMENTS

Primarily I would like to thank almighty God who helped me to come to this end. I have got helpful assistances from many persons and institutions at various levels. It is impossible to acknowledge all the individuals and institutions that supported me in conducting this study since they are so many to list by their names here. Nevertheless, I would like to take the chance to acknowledge some of them who have helped me in a special way.

I like to express deep gratitude to my adviser Mesay Mulugeta (PhD) for his follow-up, devotion of his precious time to advise and consult the researcher and timely response as need his help while doing this thesis. My work wouldn't come to this end without his tireless assistance and availability whenever I needed him for his constructive critical and valuable comments through-out the study. I am grateful to Solomon Tsehay (PhD), as thesis proposal examiner, he provides me constructive comments on the main idea of the paper at an early stage of the work.

I am indebted for Gubalafto Woreda Agriculture development office for facilitating the data collection process and providing me with required information especially to Ato Bogale Sete, Tilahun Mola, Wossen Getachew, Tadesse Belay, Samuel Tilahun, Mekdes Tesfaye and Hanna. I would like to express my special thanks and appreciation to my family's Tigist Demissie, Alem Mengesha, Belayinesh Amesal, Zeleke Tefera, Berihun Assmamaw, Desalegn Belay, Dubale Asiress and Melese Gizaw, who encouraged my study through their unlimited moral support from beginning to the end of the study. My heartfelt thanks also goes to Ethiopian Airlines Passenger schedules and Charter/lease office for their essential moral support and cover my duty while conduct data collections of the thesis. Special thanks to my friends Yihunbelay Teshome (AAU PhD candidate), Shambel Bekele (PhD candidate at Wolega University), Sitotaw Ad-masie, Abnet Sisay and Eshetu Getahun who encouraged, motivate and support my study from the beginning to end. Last but not least, I would like to express my heartfelt appreciation to Gebreamba, Layalawuha and Ezet Kebele households who were sources of data, for the time and valuable information during interview, discussion and observation.

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Acronyms and Abbreviations

ACSI:	Amhara Credit and Saving Institutions
ARSCO:	Amhara Regional State Communication Office
CSA:	Central Statistical Authority.
CSI:	Coping Strategy Index
DAs:	Development Agents
DDS:	Dietary Diversification Score
EFSP:	Ethiopia Food Security Strategies and Policy
ETB:	Ethiopian Birr
ERHS:	Ethiopian Rural Households Survey
FGDs:	Focus Group Discussions
FAO:	Food and Agricultural Organization of the United States
FCS:	Food Consumption Score
GDP:	Gross Domestic Product
HDDS:	Household Dietary Diversification Score
HHs:	Households
IFPRI:	International Food Policy Research Institution
IPCEP:	International Political Committee to End Poverty
KIIs:	Key Informal Interviews
m.a.s.l:	Meter above sea level
MoARD:	Ministry of Agriculture and Rural Development
NGO:	Non-Governmental Organization
PSNP:	Productive Safety-net Program
SID:	Simpson Index of Diversity
SPSS:	Statistical Package for Social Sciences
TLU:	Tropical Livestock Units
USAID:	United States of Agency for International Development
WB:	World Bank
WFP:	World Food Program

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Operational definitions

Bega: The season between March to May

Dega: The Amharic name for high land agro-ecology

Ezet: The name of sampled Kebele characterized by dega/highland agro-ecology

Gebreamba: The name of sampled Kebele characterized by woyina dega agro-ecology

Gubalafto: One of the local third level administrative in the region

Kebele: The fourth/bottom line of the regional administrative level

Kola: The Amharic name for lowland agro-ecology

Layalawuha: The name of sampled Kebele characterized by low land/kola agro-ecology

Mehare: The season between June to September

Quintal: The unit of measurements for weight

Woreda: The third level administrative level of regional government

Woyina Dega: The Amharic name for mid-high land agro-ecology

Abstract

Households in rural area face an increasing challenge for alternative income sources to supplement subsistence agricultural activities. The aim of this paper was to examine the determinants of income diversification and its effect on rural households' food security using a cross sectional data collected from Gubalafto Woreda of North Wollo Zone, Ethiopia. A multi-stage sampling technique was used to select 356 sample households. Structured questionnaire survey was under taken to obtain data pertaining to income diversification and its implication to food security. Additionally, key informant interview, focus group discussion and observation were the principal methods used to generate data. Descriptive statistics, ordered logistic and poison regression model were used to analyze quantitative data. The secondary data was used to support the analysis. The intensity of income diversification was calculated using the Simpson index of diversity. Results of the econometric model indicated that access to credit, access to information, training service and distance (proximate) to market were statistically significant factors at 1% and 5% probability to increase income diversification. Household size, gender (being male) and access to fertilizer and improved seeds were significant and have negative coefficient with 5% level of probability. The strategy of income diversification has significant implication on the food security status of the rural farm households in the study area. Provision of credit, training service, household access to information, engagement of rural households in non-farm income generating activities are recommending in addition to agricultural income sources.

Keywords: Income diversification, Dietary Diversity, Food Security, Simpson Index of Diversity.

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Ensuring food security remains a major global challenge, given the increasing world population, rising food demand and the adverse impact of climate change on agricultural production. Food security and poverty reduction are threatened further by the impact of climatic variability on the timing and length of growing seasons and yields, which in turn are exacerbating land degradation and contributing to water scarcity. Extreme weather events and climate-related disasters can have detrimental impacts on food security (FAO,2012).

Farm households who engage in the production of crops and livestock in Africa have increasingly sought means of escaping from the detrimental consequences of poverty by inclining to diversification of their activities within and outside the farm sector. Being pushed by variability in agricultural income on one hand and pulled in by opportunities of higher income and improved living standards by other sectors, rural households tend to allocate their assets amongst multiple activities in an attempt to increase income, risk reduction and consumption smoothing. This structural uniqueness in terms of resource endowments and factors of production often has bearings on livelihood and well-being of the people, constraining improvement in the economic conditions of farm households solely through farming operations. The mainstream of household economic theory may serve as a point of departure for the analysis of rural household diversification behavior. It considers diversification as a rational economic behavior adopted in given circumstances of constraints and opportunities (Ellis, 1998 & 2000). Rural households in many different contexts have been found to diversify their income sources, allowing them to spread risk and smoothen consumption over the year (Awoniyi et al,2009).

In order to improve the food security status in sub Saharan Africa households in rural areas largely depend on survival strategies predominantly: on-farm, non-farm, and off farm (Barrett *et al*, 2001). There exist four major elements in achieving food security, namely: availability, accessibility, utilization, and sustainability. While availability implies the physical presence of a large quantity of food, accessibility implies that there is the ability to acquire the required quantity; utilization/adequacy means sufficiency in both quantity and quality of food; and sustainability implies access at all times and not losing such access (FAO, 1996). There is an emerging consensus that the livelihood

security and wellbeing of rural households improve with the blending of non-farm economic activities with farm activities and such diversification of rural livelihood positively impacts households' food security (Agyeman *et al*, 2014a, Saeed *et al*, SEP 2017). Income diversification is also associated with higher incomes and food consumptions, more stable income and consumption over years (Bassie, 2014). and agriculture is the basic economic sector in which the country relies for its social and economic development. Its contribution to the GDP, employment, and foreign exchange earnings of the country is about 46.3%, 83% and 90%, respectively, making it as the incontestable sector in the country's development prospect (MoFED, 2006). Improved production and productivity through expansion of agricultural extension package services, increased number and education level of agricultural agents to support farmers, improved fertilizer supply, improved tenure security among farmers, improved equity in access to agricultural inputs and technologies and improved agricultural research Agricultural exports being promoted, Expanded off-farm employment and income generating opportunities and improved credit services for food insecure areas were the strategies to address food security issues. Non-farm employment provides additional income that enables farmers to spend more on their basic needs include food, education, clothing and health care (Mohammed *et al*., 2018)

Being agriculture is nature dependent and the common jobs of small-holder farmers in Ethiopia, which is characterized by poor fertility of soil, erratic rainfall, crop and livestock diseases, price shocks for crop and livestock products, climate changes and natural and human induced hazards guided to generating low income and gradually lead to food insecurity and poverty. In the context of rural Ethiopia where subsistence farming is common, off-farm activities serve as an alternative outlet to cope with unexpected income shortfalls. Given limited arable land, and low agricultural productivity to accommodate the high population growth, the significance income diversification on off-farm and farm activities cannot be overstated (Adugna, 2009). To this end the significance of this study looked at the backdrops and identify the major factors that determine income diversification activities among rural households and its effect on food security status and suggested possible intervention strategies considering the socioeconomic and biophysical circumstances of Ethiopia.

1.2 Statement of the problem

Africa as a developing region is most vulnerable to natural and human-induced hazards and disasters with severe impacts on lives and livelihoods. In consequence, hundreds of thousands of people are killed and millions affected. Agricultural production and increased risks of catastrophic flooding, recurrent drought, sedimentation, landslides, land degradation in Sub-Saharan Africa (SSA), is largely an outcome of the existing agricultural production system which is a resource poor agriculture characterized by uncertain rainfall, low inherent land productivity, lack of physical and financial capital and inadequate support services (ICSU, 2017).

Agriculture in Ethiopia is rain fed and is very sensitive to climatic fluctuations. The sector is predicted to be especially vulnerable to climate change because the country already endures high temperature and low and erratic rainfall, which limit its capacity to adapt to changing climate. The east and north part of the country are the most vulnerable to drought and are the most food insecure, even when the rains fall as expected, Ethiopia is unable to meet its food needs. Since the mid-1970s the country has had to rely on food aid almost every year to feed a great majority of its people. Poor farmers who are dependent on low input and low output rain fed mixed farming with traditional technologies dominate the agricultural sector which is often prone, very much victimized by drought (Habtamu *et. al*.,2010). The Ethiopia agricultural policies focus mainly on on-farm agricultural development to the neglect of rich opportunities for non-agricultural livelihood diversification activities. However, poverty reduction and its ultimate eradication in all its dimensions have been and still are the overriding development agenda of the Government of Ethiopia. In spite of the fact that the majority of the population has been employed in food production and fails to feed relatively large proportion of population from its domestic production where 83% participated in farming activities and only 27% were engaged in non-farm economic enterprises (MoFED,2006; MoARD,2007 and WB,2009).

A considerable body of research shows that rural households in developing countries try to maximize their food security status or minimize food insecurity and their risk exposure through agricultural intensification and the rural economy is not all about agriculture, non-farm enterprises (NFE) are important as well (Mohammed et al, 2018; Zerai and Gebreegziabher, 2011). Studies by Tesfaye (2014) and Geremew *et al,* (2017) also

indicated that, the intention of income diversification as a strategy that can boost farmers' income and promote sustainable livelihoods practices in wider practice as one of the main reasons for poverty and food insecurity of the extensive agriculture based small-holder farmers in Ethiopia. The desire to increase household income and insure against agricultural production risk has led rural households to increasingly diversify their income sources. Yet the potential roles of income diversification on food security particularly among the rural farm households have not been adequately examined in Ethiopia.

The study area is among the most-disaster prone areas where drought, crop pests, flood, frost, and hailstorms have repeatedly struck for many years. The livelihoods of the households also depend on subsistence farming. Small land holdings, environmental degradation, and population pressure have created additional complications (Mahesh and Belay, 2017). According to Gubalafto Woreda Agricultural office (2015), high population density with poor cultivated farm land, high family size (5/head on average), and low average land size (0.75/hectare/head) for highland and mid-high land, 1ha/head for low land areas), unsuitable irrigable land due to topography, recurrent drought, low livestock productivity, incidence of calamities (crop pest infestations and livestock diseases) leads the area to be dependent in food aid and food insecure. In other words, there is no empirical work available that specifically investigates the determinants of income diversification linked with food security status at household level in particular area with above agricultural production limitations. These initiate the researcher to link income diversification and food security focused on the determinant of income diversification by using household level survey data in North Wollo, Gubalafto Woreda.

1.3. Objective of the Study

1.3.1 General objective

The main objective of the study was to examine factors influencing income diversification and its effect on rural households' food security.

1.3.2 Specific objectives

Based on the above mentioned general objective, specific objectives of this study was to:

- assess the socio-economic condition and income sources of rural households.
- analyze the determinants of income diversification among rural households.
- examine the effect of income diversification on rural households' food security.

1.4. Research Questions

The motives of the study on income diversification are based on the following five basic research questions:

- What are the socio economic features of rural households?
- What are the income earning activities of rural households?
- What are the factors that determine rural households' income diversification?
- Does farm households engage in income diversification have positive effect on their food security?
- What is the extent of food security amongst farm households?

1.5. Significance of the study

Identifying the determinants of income diversification and food security assumed to help the agricultural development institutions, local food security agency and other development stalk-holders to design policies that increase the diversification pattern of households eventually leads to increase total income and food security status of households. Since the study conducted using a cross-sectional data with both theoretical and empirical emphasis, students who are interested on the area can get valuable information. Over all, this research intended to study households' determinants of income diversification and its implication on rural households 'food security in Gubalafto Woreda northern Ethiopia which was conducted at household level and may use for further research studies as reference with same thematic, socioeconomic and geographical areas.

1.6 Scope of the study

The study was a household level analysis largely based on demographic and socioeconomic information of the households. It took place in three kebeles (villages) in Gubalafto district. The analysis does not capture the dynamic impact of income diversification and causes of food security over time since it is a one-time cross-sectional data analysis. This study was also carried out in small portion of the population where the researcher believed that the issue has to be researched. Hence, it may not be applied to other areas, that might have different cultural, demographic, and socio economic patterns.

1.7 Limitation of the Study

The study centered on determinants of income diversification and its effect on food security status with limited coverage of only three sampled kebeles in Gubalafto Woreda, North Wollo zone. Lack of organized secondary data sources that support the cross sectional survey data on expected district and kebeles office may considered as limitation on this study. Rural households' income diversification and food security as well as wellbeing is not determined by only household level factor. Rather, it is very dynamic and greatly affected by community, physical and environmental factors, rules, regulations, institutions and so forth. Incorporating all these variables and longitudinal studies are important to understand the determinants of income diversification and its effect on food security situations of rural households. However, because of financial constraints and time limitation, the study couldn't incorporate all these factors. Hence, the study put them as the limitation of the study and readers should take into account these limitations for future research work.

1.8 Organization of the paper

The paper is organized into five chapters, from introduction to conclusion and recommendation. The first chapter presents introduction, statement of the problem, objectives and significance of the study. The second chapter provides review of related literature. Research methodology, sampling method and sample survey, types of data, and methods of data collection and analysis along with description of the study area is presented in the third chapter. Chapter four deals with the main body of the paper, it presents result of data analyses and their interpretation. The last chapter is about conclusions and recommendations of the study which summarizes the overall findings and forward policy recommendations.

CAHPTER TWO: REVIEW OF RELATED LITERATURE

2.1 Income diversification: The Concepts

Income diversification is linked to the concept of structural transformation at the national level defined as the long-term decline in the percentage contribution of the agriculture sector to (GDP) and employment in growing economies. Income diversification refers to the allocation of productive resources among different income generating activities, both on-farm and off farm (Abdullai, Crolerees, 2001). According to Barrett, Reardon and Webb (2001), very few people collect all their income from any one source, hold all their wealth in the form of any single asset, or use their resources in just one activity.

Other authors, Joshi.et al., (2003) and Ersado, (2003) stated income diversification as the process of switching from low value crop production to higher-value crops, livestock, and non-farm activities. “High value crops” are often defined in terms of the value per unit of weight, but it is probably more useful to define them as crops that generate high economic returns per unit of labor or land. This definition focuses on diversification as a source of income growth and a potential means for poverty reduction. Again, diversification from staple crop production into high-value activities often implies greater diversity in crops and income sources, but this is not always the case. For example, if a mixed grain-and-poultry farmer decides to specialize in poultry production, this would represent diversification into a high value activity, but not diversification in the sense of multiple activities. It can also occur at a broader scale so that there are greater numbers of occupations available to households within villages (Gebreegziabher *et.al,* 2018). Distinction can be made among growth in crop income, non-crop agricultural income (livestock, fisheries, and forestry) and non-agricultural income, which includes both off-farm wage labor and non-farm self-employment.

According to Naznin *et.al* (2015), Diversification of income is considered as an effective way to increase household wellbeing in the developing countries and it has been adopting as a common strategy to stabilize their income throughout the year and has been found to be rather the norm than the exception in developing countries. Smallholder households tend to diversify their income sources because of the need to manage risks, secure a smooth flow of income, allocate surplus labor, respond to various kinds of market failures, and apply coping strategies. Income diversification is considered an integral

component of economic development in developing countries where households derive income from both farm and off-farm sources through their labor allocations (Winters *et al.* 2010).

Other study in Bangladesh Tithy *et al.* (2016), the strategy of income diversification has significant implication on the food security status of the rural farming households. Income diversification has been identified as essential strategy for raising income and reducing rural poverty. The level and type of income diversification depends on the accessibility and availability of different income sources. Similarly, the status of food security depends on average Kcal per day consumed by all members of a household. As noted by Adebayo *et al* (2012), income diversification address as food access depends upon income available to the households, on the distribution of income within the households and on the price of food. It is ensured when households and all individuals within them have adequate resources to obtain appropriate foods for a nutritious diet which implies that income diversification is an important strategy to improve household livelihoods while access to and resource availability determine household income diversification. Therefore, the sources of income and their reliability for a steady flow and reliable amounts are important to individuals and households ensuring food.

2.2 Food security concepts and Indicators

Food security is a dynamic concept, which has continuously integrated new dimensions and levels of analysis over the years; this reflects the wider recognition of its complexities in research and public policy issues. There are more than 200 food security definitions along with its dimension across the world in different times. The most common definition of Food security is based on four important pillars (is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Food insecurity occurs at individuals, households or nation level that has neither physical nor economical access to the nourishment they need (FAO, 1996, 2012). The other definition given by IRCS, (2006) noted the food security as a person, household or community, region or nation is food secure when all members at all times have physical and economic access to buy, produce, obtain or consume sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life. The above definition is further refined into four dimensions of food security (availability, access, utilization,

and stability. For food security to exist, all four of these dimensions must be achieved simultaneously.

A research through the literature reveals that over the years, food security measures have focused on availability, access, utilization of food or the stability of food security in itself over time, or a blend of some of these pillars. Depending on the kind of data set available, be it national, regional, household or individual, the metrics have varied from one indicator to another (FAO, 2016a). On the other hand, in the recent studies, food security is defined as:

Food availability: Adequate availability of for households to meet the minimum energy requirements as recommended for an active and healthy life average value of food production should be analyzed (FAO, 2008).

Food access: refers to the resources that households have to obtain foods, either through own production or through purchase. So, individuals need to have assets or incomes to produce, purchase in order to obtain foods needed to maintain their consumption. Hence, food access is largely related to household income and own production. Food access depends on; income available to the household, the distribution of income within the household, the price of food in the market and other factors worth mentioning are individual's access to the market, social and institutional rights. Food access consists of three elements, which are physical, economic/financial and socio-cultural. The physical dimension can be illustrated by a situation where food is being produced in one part of a country but inefficient or non-existent transport infrastructure means that food cannot be delivered to another part suffering from a lack of food (WFP, 2009a).

Food utilization: refers to the nutritional benefits derived from food consumption which is related to proper food processing, storage techniques, adequate knowledge of nutrition; and adequate health and sanitation services exist. Hence food utilization is largely related to nutrition, health and sanitation (FAO 1996, WFP 2014). The same to this IFPRI (2009b) define food utilization as 'proper biological use of food, requiring a diet that contains sufficient energy and essential nutrients as well as knowledge of food storage, processing, basic nutrition, child care, and illness management'.

Food stability: refers to the stability of all other dimensions of food security over time. Even if your food intake is adequate today, you are still considered to be food insecure if

you have inadequate access to food on a periodic basis, risking a deterioration of their nutritional status. Adverse weather conditions, political instability, or economic factors (unemployment, rising food prices) may have an impact on your food security status FAO (2008). Therefore, food security to be insured at global, regional, national, household, and individual level food stability should be maintained. The food security analysis is becoming a complex concept that should be seen in a wider scope.

In the effort of addressing the multidimensional nature of food security, scholars who are working in the subject area had/have been developed/developing various techniques ranging from simple to more complex in order to measure the degree of food (in) security (WFP,2009a; IFPR, 2009). The approaches consider the issues of availability and access to food and its utilization with the acknowledgment of individual difference and household composition. Food security can be measured in different ways. The most common food security analysis techniques that are commonly employed to assess the situation of food in/security are Household Food Balance Sheet/Model, province of undernourishments, Domestic Food Price Volatility, Food Consumption Score Household Dietary Diversity Score, Coping Strategy Index, Household Food Insecurity Access Scale, Household Hunger Scale, Months Inadequate Household Food Provisioning, Anthropometry, Global Hunger Index, Household Economy Approach. An indicator should reflect a given situation or an underlying reality which is difficult to quantify directly, and usually gives an order of magnitude on a given scale. There is no best indicator, best measure of an indicator, or best analysis of an indicator in a generic sense (FAO, IFAD, WFP, UNICEF & WHO, 2017).

Depend of the study purpose all the food security metrics used by different scholars interchangeably. For this study household dietary diversity score (HDDS), Food consumption score and copping strategy index were selected due to the proxy measure of household level. Food Consumption Score (FCS) calculated frequency weighted diet diversity score is a score calculated using the frequency of consumption of different food groups consumed by a household during the 7 days before the survey. An acceptable proxy indicator to measure caloric intake and diet quality at household level, giving an indication of food security status of the household if combined with other household access indicators. While Dietary diversity represents the number of different foods or food groups consumed over a given reference period and similar to the FCS, but usually

with a 24-hour recall period without frequency information or weighted categorical cut-offs. The things that people do when they cannot access enough food. The copping strategies index measures the adjustments households make in consumption and livelihoods which can be consumption changes; expenditure reduction; income expansion (WFP and FAO,2008; IFPR, 2009).

2.3 Determinants of income diversification

In many studies (Barrett and Reardon, 2000), determining the nature and extent of diversification presents a daunting challenge for policymakers and academics alike. Income diversification is considered one of the important household strategies for securing rural livelihoods (Minot et.al, 2006). Studies by Soares (2005); Schgtman *et al*. (2006) discovered that in less developed countries more than 60 percent of the total workforce are engaged in multiple occupations all aimed at mitigate the effects of shocks (economic and agro-climatic), poverty reduction, consumption stability and overall improvement in the standard of living of the households. Multiple motives also prompt households and individuals to diversify assets, incomes, and activities. Diversification may be derived by limited risk bearing capacity in the presence of incomplete or weak financial systems that create strong incentives to select a portfolio activity in order to stabilize income flows and consumption, by constraints in labor and land markets, and by climatic uncertainty. It was found that for a vast majority of the rural population, livelihood diversification was distress driven (Sarah & Bahal, 2012).

Studies in Peru, Columbia and Honduras (Escobal *et al*, Ruben, Van den Berg, Deininger and Olinto (2001), shows that, nonfarm activities make up roughly half of rural income, though the percentage varies widely across regions and households. The share of income from nonfarm enterprises correlates positively with education, electrification, proximity to market, infrastructure development such as road and the value of crop output per hectare, others scholars, (Haggblade, Hazell, and Reardon 2002) noted that, development of road network however has mixed effects. Road improvements reduce the local cost of imported goods and goods made in urban areas, thus threatening some nonfarm enterprises such as basket wearing, roof thatching, and traditional bearing.

Income diversification affects consumption stability and the overall welfare of households. The level and the type of income diversification depend on the accessibility

and availability of different income sources and the type risk households are responding to, which may in turn depend on household's geographic location, access to factor and labor markets, human and social capital, and recurring policy changes. Empirical studies show that educational attainment and infrastructure access are strong determinants of diversification (WB, 2006). Households derive a higher share of their income from off-farm sources than from farm sources. The income from off farm sources, including remittance, depends on family size and household education. Access to education is a critically important precursor to increasing income and reducing dependence on resource-poor farms.

Study in the Western Region of Ghana and Tanzania shows that, a total of 65% of households engage in non-farm income sources. Age, number of years of education, female headed households, and household income per capita, number of extension visits, productive assets owned and nature of road were found to be significant in determining income diversification of farm households. Farm households require government and private sector support to increase the gains made in participating in various diversification strategies through policy, provision of public goods, capacity building in order to raise their living standards (Agyeman *et al*, 2014a; Dimova and Sen, 2010).

Study by Fafchamps and Quisumbing (2003), the size and composition of the household is correlated with participation in income diversification. Demographic pressures and the resulting land constraints; the lack of capital related to poverty, and of missing markets and insufficient public goods are also key constraints. Education is another important variable which positively affects participation in income diversification which implies education improves the allocation of household resources between farm and nonfarm activities (Barrett, Reardon & Webb, 2001). The author also points out better education is one of the most important determinants of non-farm income which indicated as special issue of food policy and income diversification. Similarly, the existence of credit market may have a mixed effect on non-farm activities (Ibrahim *et al*, 2009). On the other hand, credit constraint may prevent many rural households from starting some type of non-farm enterprises. Other scholar in Botswana by Lesego (2017) indicate that, taking a sample of 195 households the marginal effects on determinants of livelihood diversification showed a significant determinants of diversification activities for households are gender, age, asset category, distance to market, land ownership, farm size and extension services.

Distance to markets, access to extension services and farm size had a positive influence to households diversifying to agricultural and non-agricultural activities and significant with 5% & 10% level of probability.

In a study of rural household in Ethiopia, Fitsum (2013); Gebreegziabher, Seid and Biruk (2018) found that diversification out of crop production is associated with higher income households, a higher dependency ratio, male headed households, and location in the highlands. Tadele and Gella (2012); Woldenhanna and Oskam (2001) indicated on their study, Farm households diversify their income sources into off-farm wage employment motivated by low farm income and availability of surplus family labor, whereas they enter into off-farm self-employment to earn an attractive return. Farm households have upward-sloping, although inelastic, off-farm labor supply curves. Therefore, increasing the availability of off-farm activities and improving the wage rate received by farm households can expand the economic activity in northern parts of Ethiopia, Tigray. Lack of credit access, skill training had been major factors to participate on non-farm income generating activities.

Other studies by Adugna Eneyew (2008) and Adugna Lemi (2006); Yisihake and Abebe (2016); Agidew (2018) in Southern Ethiopia being households' male or female head, education level of household head, farm size, farm income and distance to market center have significant in number of income diversification sources. stakeholders who focus on promotion, encouragement and expansion of income diversification is expected to enhance educational level of household, to provide aids and subsidized inputs to improve agriculture which in turn increases farm income, to develop rural infrastructure, to create off-farm job opportunity and to take into consideration dwindling landholding size of households. Mulatu *et al*. (2017), Age of household head, years of schooling of household head, access to infrastructure, livestock ownerships, credits use, farm income, and locational characteristics are the main determinants of the probability/chance of households' participation in off-farm activities with 1, 5 and 10% significance level. An empirical evidenced by Mulat (2004) revealed that the family size with high dependency ratio was negatively related to household income diversification.

Other author Zerihun (2017) Studied using 2004-2009 of ERHS data revealed that, many of the variables that determine non-farm diversification were education, household size, consumption, and asset holdings reflect that non-farm diversification is pursued by

wealthier households. This situation in turn may reflect the existence of entry-barriers and for food insecurity which call for specific measures that enable poor farm households to benefit from the rural non-farm economy such as access to formal credit, infrastructure and increasing public investment in social services, mainly education and employment. The author also point-out, diversification has long been viewed as a risk minimization strategy in the face of increasing climatic and economic risks in developing countries like Ethiopia and the traditional image of farm households in developing countries has been focus almost exclusively on farming and undertake little or no rural off-farm activities. Policy debates also tend to equate rural incomes with on-farm incomes, and rural/urban relations with farm/nonfarm relations.

In addition to above authors Amare (2008), Belaineh (2013) and Asnake, (2010) studied the determinant of income diversification in Ethiopia extensively over the years and the result show that, human capital related variables, education status of the head, availability of credit and transfer income, and infrastructure related variable (proximity to market) affect income diversification of households significantly. A number of factors have been outlined as the root causes of above mentioned food security dimensions, namely, farm and family size within the households, land productivity, household income, social and economic access to assets, age of households to economically engaged in agricultural and non-agricultural activities, education, farm input (irrigation, pesticides, improved seeds and fertilizers), TLU, agro-ecology and socio-economic characteristics of the households. Almost all of these factors have been directly or indirectly linked to food sufficiency of any household and productivity of people. Thus, this study was focused on the link of income diversification with food security.

2.4 Effect of income diversification on food Security

Income is the basic determinant of food security and nutrition security (Labored *et al.*, 2013). Diversifying income gives households the opportunity to improve their income and thereby their access to food. Food access is the basic gateway to achieve food security. Higher income also allows households to diversify their food consumption. Parallel to this, with a higher income, households can access health facilities without compromising their food consumption (Woldenhanna, 2000). Sanitary conditions at household level also affect cooking and feeding practices of a household which determine the quality of food intake and thereby nutrition outcome. A higher income can also

contribute to sanitation conditions by improving households' access to facilities and equipment (Laborde *et al*., 2013). With higher income, households can also send their children to school, which has a profound impact on food and nutrition security (Ellis, 2000). These forces all together determine food security outcome of households.

Non-farm income can also be source of finance to purchase modern farm inputs that enhance labor and farm productivity (Ruben and Van den Berg, 2001; Woldenhanna, 2000). Agricultural inputs and irrigation practice increases dietary diversity and directly contributes to food and nutrition security (Headey *et al*., 2012). It is also believed to be family labor engagements in off-farm activities affect the labor supply and time use in households due to a shift in resource when households decide to diversify. Labor and other household and farm assets might be diverted, which could create scarcity to farm activities as well as other household activities (Ruben and Van den Berg; Woldenhanna and Oskam, 2001). This could decrease farm productivity, which in turn lowers food availability and access. Households' time and labor use change might also affect cooking and consumption practices. These processes may challenge enhancement of food security, and consequently nutrition security. Nevertheless, there is also a possibility to use non-farm income to employ labor in farm. Income diversification is also considered as a risk spreading strategy (Ellis, 2000) in a form of self-insurance. It is claimed that livelihood diversification gives the opportunity to spread risk along various income generating activities which increases resilience (Davis *et al*., 2014). This helps households to smooth out their consumption and access necessary health facilities. But, income diversification as a risk strategy works if households engage in different activities that do not have similar risk covariates. Moreover, diversifying income is not always voluntary and rewarding. It can be taken as a livelihood strategy due to lack of alternatives, and households might engage in less productive activities, and end up in more vulnerable situations.

The development of new income sources has direct as well as indirect impact on improving the condition of food security status of the rural households. Food access depends upon income available to the households, on the distribution of income within the households and on the price of food. It is ensured when households and all individuals within them have adequate resources to obtain appropriate foods for a nutritious diet. Therefore, the sources of income and their reliability for a steady flow and reliable

amounts are important to individuals and households ensuring food security (Zerai & Gebreegziabher, 2011a). Currently, greater proportion the population of Ethiopia consumes food of less than 2,100Kcal/day. At different areas food insecure groups employ different survival strategies/mechanisms to handle food insecurity by mobilizing all available resources to resist the food insecurity problem in Ethiopia. This mechanism extends up to involving in criminal activities.

It is increasingly believed that diversification of income sources of the households and widening of crops options by the farmers during cultivation have positive impact on the food security level of rural households' evidence from various studies also indicates that if households have diversified sources of income it increases their total monthly income and this has a positive impact on food security level of the households. Diversification of income sources has been put forward as one of the strategies that households employ to minimize household income variability and to ensure a minimum level of income diversification which reduces poverty and enhances the national food security as well as the security of rural farmers (Tithy *et al,* 2016).

Income diversification affects consumption stability and the overall welfare of households. Bernard et.al (2014) conducted study on the analysis income diversification strategies and food security stratus of farmers in Oyo State of Nigeria, Africa indicated that, education, household size, credit and extension contact variables were positively related to income diversification and food security. The estimated coefficient of income diversification was positive and significant at 5 percent level of probability which implied that as income diversification increases, food security status of the farmers also increases. Every household has a limited amount of resources (household income) at its disposal, including assets, labor, human capital, and natural resources from which they derive their main source of livelihood. The availability and access to income generating activities determine the ability of families to buy food (Zerihun *et al*, 2015). Income diversification is considered as the most important strategy for raising income and food security status in Ethiopia. From the above review it is clear that income diversification has significant impacts on households' food security status.

Kidane, Alemu, and Kundhlande (2005) analyzed determinants of food security in Oromiya region of Ethiopia using cross-sectional rural household survey data. The authors used logistic regression to identify the determinants of food security in the region. The empirical evidence revealed that access to fertilizer, educational level of household heads, access to land, access to family planning improve the probability of food security in the study area. As the food insecure households are resource poor, living in drought prone and degraded areas, focusing on crop and livestock production alone may not entirely solve the problem of food insecurity. For these areas income diversification through non-agricultural activities is important. To this effect, the food security program considers complementary income sources in non-farm activities (EFSP 1996, 2003). Thus, it is important to identify the major factors influencing income diversification strategy activities and its effect on food security status of rural farming households and suggest possible intervention strategies of income diversification of smallholder farmers, considering the socioeconomic and biophysical conditions of Ethiopia.

2.5 Literature gaps

The determining factors of income diversification such as: age, market access, gender, credit access, productive asset ownership, irrigation access, good infrastructure, availability of agricultural input (fertilizer, pesticide and improved seeds), farm and family size, among other factors have been found by empirical studies. However, the determinants of income diversification differ from one geographical location to another owing to spatial variations of farm/non-farm economies across the region (Abdullai, 2000 and Minot et al, 2006; Knudsen and Tidsskrift, 2007). Moreover, farm households are confronted by different incentives and constraints due to the differences in transaction costs and market prices they face. This culminates into heterogeneity in the kind of income diversification strategies within farm households persuaded (Barrett et.al, 2005). Therefore, assessing the determinants of income diversification in the Northern Ethiopia particularly Gubalafto Woreda is expected to appropriately facilitate and recommend some basic points on households' income diversifications mechanisms to be support by local governments and NGOs respectively.

2.6 Conceptual Framework

As depicted on below conceptual framework, the ability, willingness and the need to diversify highly depends on the access to the different types of assets like physical, human, social, financial and natural capital. The review of literature leads to design a conceptual framework describes the relationship between dependent and independent variables. The essence of conceptual framework is the foundation for the data collection process and shows the necessary data to be collected, processed, and analyzed. The conceptual framework used in this research to link the determinant factors associate with accumulation of assets and incomes activities with rural households' food security.

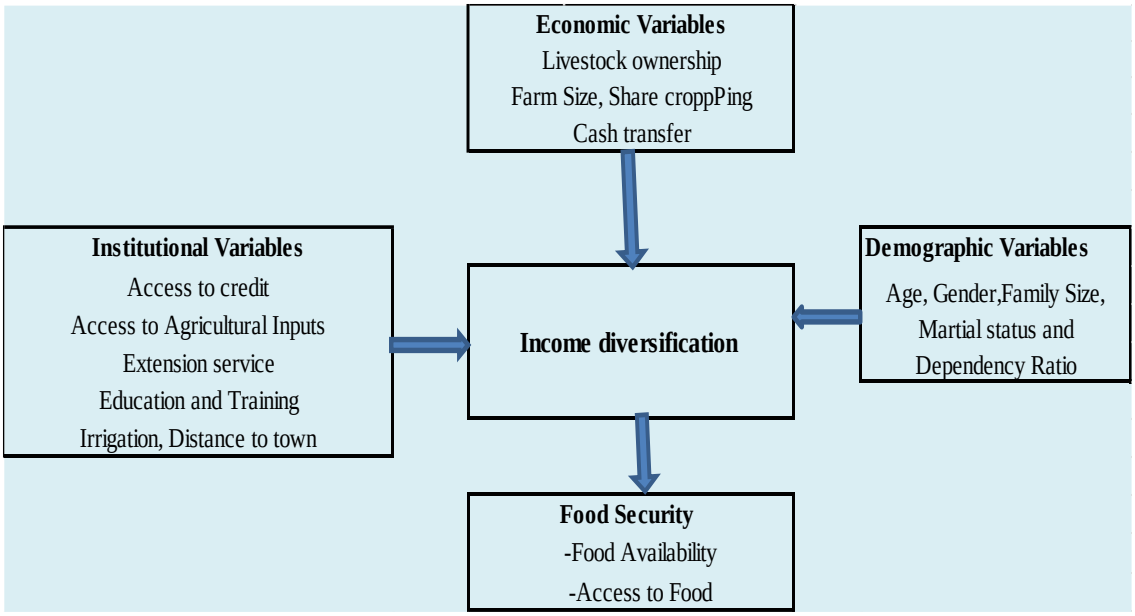

Figure 2.1: Conceptual framework (sources: own construction based on the literatures and empirical review).

The conceptual framework for this study builds based on the context of study area drawn from institutional, socio-economic and demographic variables. Such framework is the indicators of households' endowments that determine the behavior of these households regarding activities participation. It is obvious that rural household activity participation is strongly influenced by assets endowments. These assets are the bases for household ability to participate in activities to generate income. The Assumption is that, households have opportunity to access assets namely: physical capital (land, and productive tools), human capital (education status, Training, skills and experience), social capital (networks and being membership in formal and informal organizations), natural capital (common properties natural resources) and financial capital (availability of credit, remittance, cash

transfer, and social safety nets) have a tendency towards income diversification which results to avail and access food through production and purchase.

The concept of income diversification strategy has become central to rural households' agricultural and non-agricultural activities in recent years. However, give the uncountable possible proportional mixes of activities undertaken by a household, it is not always clear what constitutes a distinct income diversification rather than just a slightly different mix of activities within the same general livelihood. The farm and non-farm sectors can be linked directly via production linkages, which occur either upstream or downstream. Factors external to the household influencing decision-making are the agro-ecological, socio-economic environment and demographic conditions of rural households. The main components of the latter are the access to institutions (such as for agricultural extension and credit), agricultural technologies, infrastructure and the access to agricultural input and output markets. These components determine the level of household income diversification (Miyuki *et al*, 2008).

Rural households have various motives for diversifying their income sources and generation patterns instead of concentrating on agriculture with its potential gains from specialization. Some mainly risk reducing and others simply coping devices to protect consumption once a shock has taken place (Ersado, 2003). Such strategies typically involve maintaining a diversified portfolio of livelihood activities and social support capabilities to shelter one from or cope with shocks. Income diversification is one of the most common components of such strategy undertaken to manage risk and sustain a livelihood. In economic terms, seasonality implies varying returns to labor in both on-farm and off-farm activities during the year causing seasonal changes in occupation as labor time is switched from lower to higher return activities (Sarah, 2015). Other studies revealed (Reardon, 2000, 2006), the reasons for income diversification had been Seasonality causes associated with problems of mismatch between constant consumption needs and uneven income flows. The dependent variables were income diversification as a center while the independent variable were institutional, socioeconomic and demographic variables which were influence rural households' income diversification level with the assumption that the independent variables could influence significantly rural households' agricultural and non-agricultural activities and also influence food security. The effects of each independent variable explained on chapter three (3.4.3).

CHAPTER THREE: DESCRIPTION OF THE STUDY AREA AND RESEARCH METHODES

3.1 Description of the study Area

3.1.1 Study Location

The study was conducted in Gubalafto Woreda, Northern Ethiopia. It is one of the nine Woreda in north Wollo zone with bordered on the south by the Debub Wollo zone, on the west by Delanta and Wadla, on the northwest by Meket, on the north by Gidan, on the north-east by the logiya river which separates it from Kobo, and on the southeast by Habru. Geographically the area is located between $39^0$6'9" and $39^0$45'58''longitudes east and $1^0$34'54''and$11^0$58'59'' latitudes North. Weldiya is an enclave inside this Woreda. The topography of the Woreda is mostly characterized by a chain of mountains, hills and valleys ranging from 1,379- 3809 meter above sea level (m a.s.l) with a total geographical area of the district is about 1,042 km^2. It has three Agro-ecological Zones namely, Lowland (kolla (18%) 1379-1,500 m a.s.l,Mid-altitude (Woyina dega 48%) 15,00-2,300 m a.s.l, and Highland (dega 34%) 2,300-3200 m a.s.l. (WARDO, 2016 and Belay,2017).

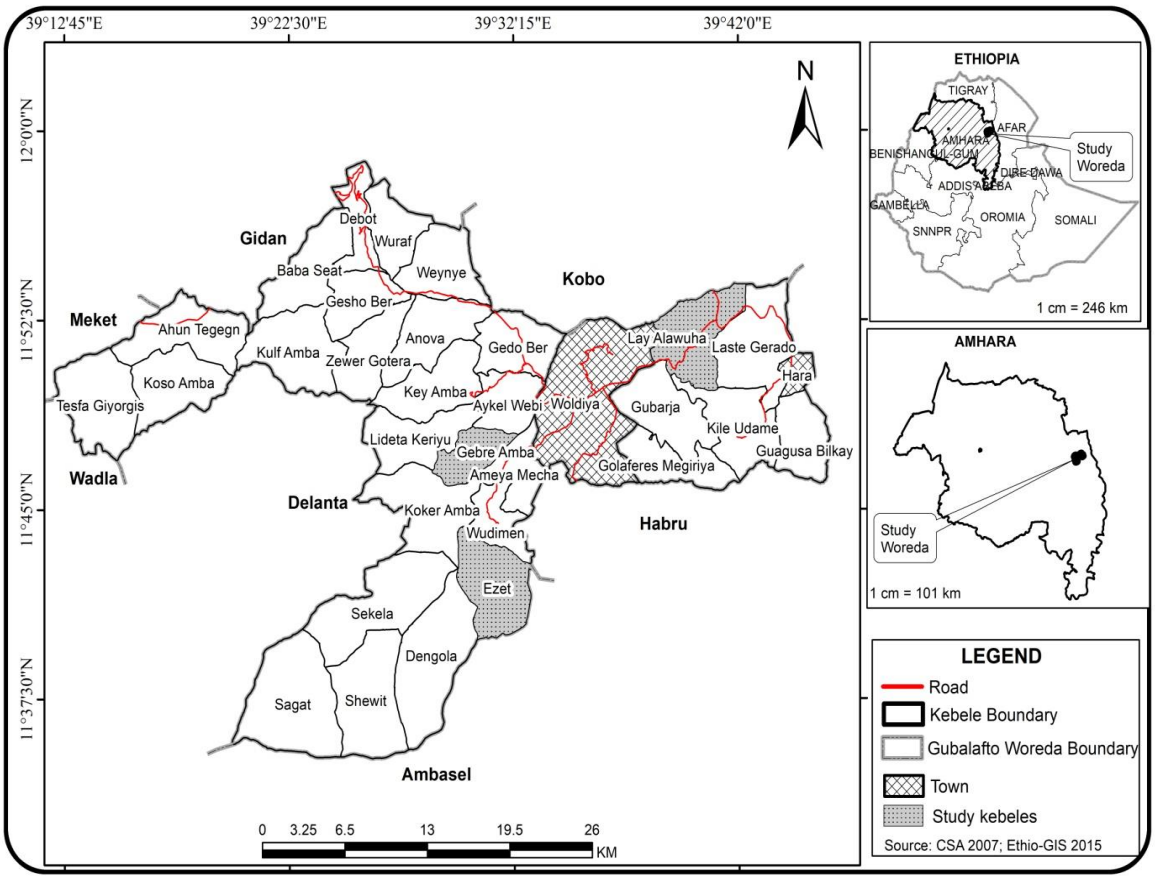

Figure 3.1: Map of the study area (Ethio-GIS, 2007)

The district's rainfall has bimodal characteristics. The small rainy season (belg) lies in between March and May and the long rainy season (Meher) remain in between June and September. The nature of the rainfall is erratic, short in duration and poorly distributed temporally and spatially. Crop production in the highland areas (dega) usually depend on belg rain, whereas the Woyina-dega and kolla areas depend on Meher rain. The mean monthly temperature ranges between 24.0^0C and 31.1^0C, respectively (SARI, 2018).

3.1.2 Population

According to the Gubalafto Woreda Demography office (2016/2017), Gubalafto district has a total population of 159,769 which shows an increase of 0.48% over the 2007 census. Of which, 50.6% are men and 49.4% women; and only 3.49% are urban inhabitants. With an area of 900.49 square kilometers, Gubalafto has a population density of 155.28 which is greater than the zone average of 123.25 persons per square kilometer. Most of the rural population is settled on the highlands and plateaus. About 32,824 housing units and 33,676 households were counted in this Woreda. The average persons to a household were 5 From this, total household heads of the three sampled kebeles were 3,220.

3.1.3 Livelihood and Food Security in Gubalafto Woreda

According to North Wollo zone PSNP Coordinator Office, all nine rural districts of North Wollo zone including Gubalafto district have been grouped amongst the 48 districts identified as the most drought prone and food insecure districts in the Amhara Region State. Many factors are associated with the miserable life of North Wollo rural households. These are low agricultural productivity, cyclical drought and an unreliable and inadequate rainfall system, crop failures because of pests and high population pressure on a limited arable land. In addition to this, the bad governance has added a new dimension to the problem of farmers. Even in good years, farmers cannot sustain themselves on the basis of its agricultural production alone (Sorensen et al., 2004). About 96.51% of district population lives in rural areas and their livelihood is generally depending on smallholder subsistence mixed agriculture, where both crop and livestock productions are practiced under the same household unit. According to the study of MoARD (2007), the district has two different livelihood zones i.e. the North Wollo east plain livelihood zone and North Wollo highland belg livelihood zone. The highland belg livelihood zone can be characterized as belg dependent, chronically food insecure and

has a long history of food aid. The dominant crop is barley, with wheat, oats, pulses and flax. In this district animal rearing is also done and the main animals are cows, oxen and sheep. Sale of livestock and livestock products have considerable contribution to household ‘s income. Drought, pest infestation, livestock disease and frost are the main chronic hazards in this livelihood zone which occur annually with varies intensity except drought that occurs one in every three years. Kola livelihood zone is Meher dependent which is found in lowland areas. It has relatively moderate land holdings, fertile soils, and good rainfall though not reliable and is generally believed to be food sufficient livelihood zone. Crop pests such as stalk borer which affects sorghum and maize and the shoot fly which mainly affects Teff are the main chronic hazard in kola livelihood zones.

Table 3.1 shows the average crop productivity per hectare in Gubalafto Woreda. The mid-highland agro-ecological zone grown all the major staple food crops within the district of the study area. Some of the food crops only adapt highland (Dega) agro-ecology namely barley and wheat. Teff and sorghum is the major food crops for majority of households both in mid-highland (woyina dega) and low land (kolla) agro-ecology. The average crop land productivity for the district was maize (45), sorghum (32), wheat (24), Teff (21), Barley (18) quintals per hectare respectively. The remaining crops are legume crops such as chickpea (12), bean (12), and pea (11) quintals per hectare on average.

Table 3.1: Average land productivity of the Woreda

Crop type	Unit	Amount/hectare	Agro-ecology
Maize	Quintals	45	W/dega, Kolla
Teff	Quintals	21	W/dega, Kolla
Wheat	Quintals	24	Dega, W/dega
Barley	Quintals	18	Dega, W/dega
pea	Quintals	11	Dega, W/dega
bean	Quintals	12	Dega, W/dega
chickpea	Quintals	12	W/dega, Kolla
Sorghum	Quintals	32	W/dega, Kolla

Sources: Gubalafto Woreda Agricultural office, 2017/2018

PSNP has two benefit modalities for six months: cash/food for work i.e. for those who can provide labor for public works, and direct cash/food support i.e. for those who cannot provide labor such as disabled and aged people. The benefit is 15 kg wheat, 1.5 kg pulse and 0.5-liter oil per month per individual or equivalent of its cash or combination of cash and food. In addition, supplementary food is distributed to malnourished children and lactating women. Rural credit packages are also available for investment in livestock, petty trade and new agricultural technologies (GWAO, 2018).

It is the fact that early warning, disaster prevention and preparedness had been done before and after recurrent drought, flood and other catastrophic events occurred. Table 3.2 show beneficiary trends of early warning, disaster prevention and preparedness within Gubalafto Woreda. It shows increasing but decline at the third year of intervention period. This implies that a reduction the number of beneficiaries indicated the household were recovered from shocks and rehabilitated the livelihood activities within the districts. The type of intervention held by the local government and humanitarian aid non-governmental organization were food aid, direct cash support, training and emergency humanitarian aid and inclusion of direct PSNP. As disused with key informant interview and FGD, the selected groups forwarded the effects of catastrophic events within the study area as a common phenomenon and the important of income diversification to curve the adverse effects of events were noted.

Table 3.2: Beneficiary trends on early warning, disaster prevention and preparedness

Year	**2016/2017**	**2017/2018**	**2018/2019**	**Intervention**
1st quarter	24,600	30,000	29,480	Provide training, Food aid, Direct cash, support emergency relief sand humanitarian aid.
2nd quarter	22,870	27,478	30,000	
3rd quarter	17,000	22,000	17,240	
4th quarter	16,500	19,500	12,240	
Total	80,970.00	98,978	88,960	

Sources: Gubalafto Woreda Early warning and disaster prevention office, 2018/2019

3.2 Research Methods

3.2.1 Research Design and approach

The researcher used a cross sectional research deign was used to conduct this research. Qualitative and quantitative approaches were also employed. The integration of quantitative and qualitative data in the form of a mixed methods study has great potential to strengthen the accuracy and augment the analysis and findings of this research. To this end, the researcher used a mixed method approach which develop methods of research that advances the systematic integration of quantitative and qualitative data within a single survey. This was done by carefully selecting the mixed method design that best suits the survey questionnaires and meets its resource constraints, facilitate deeper understanding of both enumerators and respondents and more meaningful regarding the effectiveness of selected model and analysis.

3.2.2 Sample size determination and sampling techniques

On the basis of Israel (2013) sample size determination formula, 356 sampled respondents were calculated. Using a balanced rate, the number of sampled households were taking from each three selected kebeles.

$$n = \frac{N}{1+N(e)2} \quad \text{..... (1)}$$

Where n is the sample size, N is the population size, and e is the level of precision. Using this formula, the researcher calculates 356 sampled households with 95% confidence level. This sample assumed as representatives of the entire population due to homogeneity of the sampled households in each stratum.

Table 3.3 Sample size

Sampled Kebele	**Number of Farm households**	**sample households**
Ezet (Dega)	1072	119
Gebreamba(Woyina Dega)	1233	136
Layalawuha (Kolla)	915	101
Total Population	**3220**	**Total Sample = 356**

This study used multi stage sampling techniques. At the first stage the Woreda selected purposively. At the second stage, the Woreda consisting of 34 kebeles grouped into three

strata based on agro ecological characteristics (Dega, Woyina Dega and Kolla). Then, a purposive sampling technique was employed to select the three rural kebeles out of the existing 34 kebeles based on 20 km radius of *Woldia town* in-terms of transport network. The sampled households were selected using systematic random sampling methods by taking lists of households from each sampled Kebele administration office. The researcher arranged lists of households alphabetically and taking sampled households in every 5^{th} intervals and repeated the process until sampled number fulfil. This ensures the representation of the total population and results in more reliable and provides detail information. These kebeles are Ezet, Layalawuha, and Gebreamba. The household questionnaire was pretested in the three selected kebeles and modified before the survey work conducted.

3.2.3 Data collection techniques

Data was collected using key informant interview, focus group discussion, interview schedule using structured questionnaire and Documents from Woreda agricultural office, Amhara credit and saving institution, Woreda food security office, Woreda Trade and industry office (medium and Small-scale enterprise) and other relevant reports reviewed to support the primary data and have detailed information.

Questionnaire survey: Questionnaire based survey was administered to sample farming households by using a standard questionnaire after obtaining the consent of the respondents as a research ethics. The questionnaire translated in to Amharic language for the purpose of simplicity and ease of communication between the enumerators and the respondents. with this techniques, data related to households natural capital such as land size, Financial capital such as access to credit, remittance, Cash transfer, human capital such as level of education, skill, demographic variables, (age, family size, sex; Socioeconomic variables, livelihood profiles of rural households (household assets, activities, and other socio-cultural and contextual information); major sources of household income (agricultural and non-agricultural income sources) were collected. Data collectors were well oriented on the issue of data collection procedures and ethics. Pilot study was under taken for pre-testing the questionnaire in order to estimate the time needed to complete and validity of the data to be collected. Then, the questionnaire edited in light of pilot study.

Key Informant Interview (KII): In addition to the cross-sectional survey to be carried out key persons in sampled kebeles were interviewed using KII. The KIIs includes, one DA team leader, one food security and livelihood expert, one small and medium enterprise expert, and one Kebele administrator were interviewed to obtain relevant information.

Focus group Discussions (FGDs): Three FGDs carried out from the three identified kebeles and having nine members with mix of participants. The composition was one Kebele administrator, three male households' heads, one women household head, one agricultural cooperative union representative and three developments agents. The members were selected on the basis of their role and participation within the given selected study kebeles. The participants respectfully requested for their consent, time and the information they were provide.

Field observations: Field visit was performed by researcher to support supplementary information obtained through other primary and secondary data collection tools. The biophysical, socioeconomic condition of the area explored through the field observations. In the meantime, development agents and micro and small enterprise experts were participated in filed visits. Check list was used to record what the researcher observed.

Secondary data sources: Beside the above mentioned data collection techniques and procedures, intensive desk review of published and unpublished literatures such as books, journals, articles, reports and e-resources was carried out. Documents from Woreda agricultural office, Amhara credit and saving institution, Woreda food security office, Woreda Trade and industry office (medium and Small-scale enterprise) and other relevant reports reviewed to support the primary data and have detailed information.

3.2.4 Data Analysis techniques

Quantitative data collected from questionnaire survey and the secondary data sources that were collected from different sources analyzed using SPSS version 24 and STATA 14.2 in order to describe key findings and socioeconomic conditions obtained from the data.

Descriptive Analysis: Descriptive statistics such as frequency, percentage, mean and standard deviation were used to describe the socio-economic characteristics of households to show the sampled households income diversification trend, user and non-

user of selected agricultural inputs, and to see the cross tabulation between diversified and non-diversified households, average income of the households', deviation of household income from the mean in each income generating activities as well as the dietary diversify level with respect to food categories.

3.2.4.1 Food Security specialized techniques

Dietary diversity (DDS): In relation to other food security indicators used in a cross-sectional livelihood survey that included 356 randomly selected households within three rural kebeles in Gubalafto Woreda. HDDS was used to measure food Security Status of rural households linked with income diversification and see cross tabulation of each indicator in accordance with each income sources.

Copping Strategies (CSI): Coping Strategy Index (CSI) is a type of subjective or behavioral food security measurement. It is a quick and simple indicator of household food insecurity behavior, which usually used for emergency food security assessment. It arises from the fact that there are several common behavioral responses to food insecurity by households at the time of food shortages. These responses are called cope mechanism or strategies. Due to repeated recurrent drought and shocks households face in the study area, the assessment of households coping strategies found to be an important food security technique in the study of income diversification and food security status of rural households. This method has 13 standard questions designed in CSI, which is recognized as universal (standard) coping behaviors regardless of geographical locations (Maxwell & Caldwell, 2008). However, this study selected10 relevant behavioral questions specific to study area, out of 10 each surveyed household was asked about whether they have used these coping strategies during the last 30 days (before the survey), and a follow up question of how often out of the 30 days. The frequency severity value ranges from 0 to 4 where 0 (Never), 1 (Hardly at all, <1 time/week), 2 (once in a while;1-2times/week),3 (pretty offten;3-6 times/week), and 4 (always; every day).

Food Consumption Score (FCS): Food consumption score is an indicator of food security which takes into consideration the diversity, quantity and adequacy of food consumption. It is a frequency-weighted dietary diversity score, calculated using the frequency with which a household consumed eight food groups (i.e., staples (2), pulses (3), vegetables (1), fruits (1), meat/fish/egg (4), milk (4), sugar (0.5) and oil (0.5)) with a 7-day recall from the date of the survey. The frequencies of food consumption shall not be more than seven which is equal to number of the recall period. Each food consumption frequency is multiplied by its weights (given in parentheses above) and then summed to create the FCS. The score ranges from 0 to 112, where 0 indicate a household didn't consume any food in the last 7 days and 112 when household consumed each food groups all days for the last 7 days. In FCS, there are two kinds of cut-off that determine the status of food security depending on the frequency of consumption of oil and sugar in the society. If the consumption of oil and sugar is proportional or positively correlated with other category of food, we used 21 and 35 thresholds to determine the food security status based on FCS. Therefore, below 21 is considered as poor, above 35 acceptable and between 21 and 35 as borderline. However, this can be raised from 21 and 35 to 28 and 42 if populations where consumption of sugar and/or oil is frequent among nearly all households surveyed, even when the consumption of other food groups is rare (WFP, 2008).

3.2.4.2 Analysis of qualitative data

The qualitative data that obtained through KIIs, FGDs and observations interpreted and analyzed through focusing in providing meaningful explanations. It used to explain the general livelihood condition of the households and identify the constraints of agricultural and non-agricultural income diversification activities and household food security status along with the socioeconomic and biophysical conditions in the study area. Moreover, perception of respondents with regard to major factors associated with income diversification and food security were noted and underlined in the qualitative analysis.

3.2.4.3 Econometric Analysis

Using the econometric techniques, the study used three models where in the first model estimates income diversification for the entire sample for which households' choice of diversifying or not diversifying are considered in the light of number of sources a household obtains income from each sources. The second model analyzes the determinants of income diversification with the assumption that rural households are wing for each income generating activities. The third model used to assess the link between income diversification and rural households' food security.

1. Simpson Index of Diversity (SID)

This study employed the Simpsons Index of Diversity (SID) taken as binary logistic regression value where a value of 0 indicates that a household does not diversify, 1 any value greater than one income sources.

$$D = \frac{n(n1-1)+n2(n2-1)+n3(n3-1)\ldots+nk(nk-1)}{N(N-1)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textit{(2)}$$

Reduced form as $\mathrm{SID} = 1 - (\sum_{i=1}^{n} \mathrm{pi}^2)$…… (3)

Where, Pi = proportion of income coming from source i, the value of SID always falls between 0 and 1. If there is just one source of income pi = 1 so SID = 0. As the number of sources increase, the shares of pi declines, as does the sum of the squared shares, so that SID approaches 1. If there are k sources of income, then SID falls between zero and 1-1/k. The closer the SID is to zero, the more the specialization, and the further it is from zero, implies the more diversification (i.e. the smaller the index value, the higher the degree of income diversification). An understanding of the degree of income diversification in the study area assumed as basis for advocating from households involve in rural farm and non-farm economy appropriately and respond to the needs of farm households to diversify their income.

2. Econometric Model

Depending on the scope of diversification that the study focused on, many studies have used different econometric models to estimate determinants of income diversification. Ordered logistic regression model used to identify the factors which determine farm household engagement in income diversification. This technique used when the dependent

variable is ordered categorical, in which case the events of dependent variable is ordered (Schwarze S. and Zeller M. (2005) :), Babatunde and Qaim (2009), Davendra et al. (2005), Bealu (2018). This study used the ordered logistic regression technique with dependent variable income diversification includes income sources from both on farm and nonfarm activities; and categorized as No diversification (SID ≤ 0.01); Low level of diversification (SID = 0.02- 0.25); medium level of diversification (SID = 0.26-0.50) and high level of diversification (SID> = 0.51). This have impact on food security status of households as the more diversified assumed have more food secured in the assumption that the household get diverse food sources as income increase. For more than one independent variable, that is for K independent variables (X1, X2, ….Xk), can be written as the derivation of the ordered logit model.

$$Prob(Yi = j|xi) = \frac{e^{\beta'_j x_i}}{1 + \sum_{k=1}^{J} e^{\beta' kxi}} \; for\; j = 0,1,2,\ldots.,J \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Let y be an ordered response taking on the values {0, 1, 2. . . J} for some known integer J. The ordered logit model for y (conditional on explanatory variables x) can be derived from a latent variable model. Assume that a latent variable y* is determined by

$$yi^* = \beta ixi + ei,\ e/x \sim \text{normally}\ (0, 1) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where β is Kx1 and, for reasons to be seen, x does not contain a constant. Let a1 <a2< - - - <aJ be unknown cut points (or threshold parameters), and define as"

$$yi = 0 \quad \text{if } yi^* \leq a1$$
$$yi = 1 \quad \text{if } a1 < yi^* \leq a2$$
$$yi = 2 \quad \text{if } yi^* \leq 3$$
$$yi = J \quad if\ yi^* \geq aJ$$

Given the standard normal assumption for e, it is straightforward to derive the conditional distribution of y given x; we simply compute each response probability:

P(y=0/x= p(y*≤a1/x=p(xβ+e≤a1/x) =Δ(a1-xβ)

P(y=1/x= p(a1< y* ≤a2/x) = Δ(a2-xβ)-Δ(a1-xβ)

P(y=2/x= p(a2< y* ≤a3/x) = Δ(a3-xβ)-Δ(a2-xβ)

P(y=J-1/X= p(aJ-a1< y* ≤aJ/x) = Δ(aJ-xβ)-Δ(aJ-xβ)

Many statistical packages routinely estimate ordered logit model. Xi = X1, X2, X3….. Xn : are the independent variables used in the model. Bi = B1, B2, B3…… Bn : are the regression coefficients indicating the magnitude of change (increased or decreased participation income diversification) in the independent variable. As noted on Gujarat

(2004) and Greene (2003), the marginal effects proposed as followed for ordered logit model.

$$\frac{\partial p_0(x)}{\partial x_k} = -\beta_k \Delta(\alpha 1 - xi\beta), \frac{\partial p_J(x)}{\partial x_k} = \beta_k \Delta(\alpha J - xi\beta)$$

$$\frac{\partial p_j(x)}{\partial x_k} = \beta_k [\Delta(\alpha_{j-1} - xi\beta) - \Delta(\alpha J - xi\beta), \quad 0 < j < J$$

.....(6)

In general taking as yi* as a random variable of the Simpson diversity Index (SID), βi is a parameter to be estimated, xi is a vector of explanatory variables determine income diversification and εi is the error term. Hence each of the explanatory variables and coefficients effects calculated as below.

$y^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... \beta_{n+1} X_{n+1} + e_i$ ..... (7)

$y^* = SID = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... \beta_{n+1} X_{n+1} + e_i$ ..... (8)

In view of the fact that the Dietary Diversity Score is count data rather than continuous variables, a linear regression may not be appropriate in estimating its determinants. While the log transformation for y Poisson can give something reasonably close to the normal distribution (Olajumoke *et al*, 2015). The number of different food groups consumed represented by the HDDS is the measure used for household food security in this study (dependent variable). Since it is a discrete variable and appropriate to use a model for count data based on a Poisson distribution. Following Fontana et al. (2006) along with Greene (2000), the study defines y_i as the number of food groups consumed by the household i in the past 24 hours leading to the survey period (where i=1, 2…,12). The variable y_i is assumed to be distributed as a Poisson distribution with parameter λi given as:

$$P(Yi=yi) = e^{-\lambda} \lambda_i^{yi} / yi! \quad \text{..... (9)}$$

Where λ_i $_{is}$a vector specified by a vector of covariates X_i that determined by the explanatory variables. More often $\lambda_i$will be log linear function which assumes the form:

$$ln\lambda_i = \beta_i x_i \quad \text{..... (10)}$$

The log linear model guarantees that the number of food groups consumed by the household is a non-negative integer and is given as:

$$E(y_i/x_i) = \beta_i = e^{\beta' x_i} \quad \text{..... (11)}$$

The empirical model is given as:

$$yi = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_{n+1} X_{n+1} + \varepsilon i \quad \text{.....(12)}$$

$$yi = DDS = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_{n+1} X_{n+1} + \varepsilon i \quad \text{.....(13)}$$

condiments (e.g. salt). The number of groups reported was then summed to obtain an HDDS (0 to 12) for the household as a whole (Swindale and Bilinsky, 2006; Kennedy et al., 2013). Foods included in HDDSs were from different sources, namely: (i) foods purchased, (ii) home-produced foods (i.e. production for own consumption), (iii) foods received as gifts, and (iv) foods eat outside the home.

The other food security metrics is the coping strategies index (CSI) which is an indicator of household food security that is relatively simple and quick to use, straightforward to understand, and correlates well with more complex measures of food security. A series of questions about how households manage to cope with a shortfall in food for consumption results in a simple numeric score. In its simplest form, monitoring changes in the CSI score indicates whether household food security status is declining or improving (USAID, 2008). The basic idea is to measure the frequency of these coping behaviors (how often is the coping strategy used?) and the severity of the strategies (what degree of food insecurity do they suggest?). Information on the frequency and severity is then combined in a single score, the Coping Strategies Index, which is an indicator of the household's food security status.

3.2.5 Description of Variables

1. Dependent variables: the researcher used two dependent variables, these are:
Simpson index of diversity (SID) measured as ordered values with four level of categories such as "No diversification (SID ≤ 0.01); Low level of diversification (SID = 0.02- 0.25); medium level of diversification (SID = 0.26-0.50) and high level of diversification (SID> = 0.51). This was used to estimate determinants of income diversification using ordered logistic regression model.

Dietary diversity score (DDS) used to examines the effects of income diversification on households' food security using poison regression model. The DDS measured as a diver score of categorical threshold level as <4 food count (low diversity level), 4.5-6 food count (medium diversity level) and >6 food count as high diversity level.

2. Independent Variables: Various socio-economic and household characteristics variables are expected to affect rural livelihood diversification in the study area. The major explanatory variables hypothesized to influence positively or negatively on the

household to diversify their income sources or not are described below. The analysis includes various factors that have bearing on the dependent variable which includes the demographic and institutional variables expected to affect households' income diversification and its effect on food security status.

Sex of household head (SEX): This gender variable was included in the model to see whether male or female households engaged in income diversification. It is a dummy variable that is assigned 1 if the household is male and 0 otherwise. It is expecting that being male has positive relationship with income diversification for the reason that in most developing countries females engaged in farm self-employment.

Age of household head (AGE): It is a continuous variable measured in the number of years of the household head that indicate the experience in the livelihood and working capacity. Even though it is not easy to expect that this variable is very significant in the specified model, it helps us to predict how income diversification will go against the age of the household. It is expected that to some extent the age of the household helps to diversify income through experience and after some maximum point the effect will start to decline.

Marital status of household head (MBS): is controlled to see whether the married or the single household are more engaged in income diversifying activity. It is a dummy variable where 1 is assigned to married and 0 is assigned to single. It is expected that because of low labor resource that the unmarried household has, their engagement in income diversification is lower than that of married ones. The reason to use only dummy 1 and 0 is there is no divorced and windowed in sampled households.

Family size of household (FSZ): It is a discrete variable, which refers to the number of family members of household. A large family might be forced to divert part of its labor force into nonfarm activities to generate more income for coping strategies at the time of shocks. The expectation is that more the labor force in the household, the higher the probability that the house hold engaged in different income generating activities.

Education level of household head (EDU): Education level is a continuous variable, which can be measured in years of schooling. It is expecting that the more the household increase the level of education the more to increase income and food security.

Training service (TRG): Access to training is a dummy variable expected to have positive influence on dependent variables due to the fact that providing agricultural and non-agricultural training for rural households enhance income diversification and improve food security.

Access to irrigation (IRI): Availability of irrigation to household farm production and measured as dummy variable 1 household has irrigation facilities and 0 otherwise. Being access to irrigation facilities will increase to households' farm income from different sources which will have also positive effect on food security through diversify food sources and used for doing non-farm activities, particularly self-employment activities.

Farm Size (FAS): The total amount of farm land that the household possess and this farm size is measured in hectare. It is a variable that represent the physical capital of the household. As land declines the household is forced to work on alternative income generating activities.

Share Cropping (SHC): It is a dummy variable to have more land in households for agricultural activities and expect to have positive implications to diversify farm production and increase household income.

Livestock ownership (TLU): It is a continuous variable, which refers to the numbers of livestock owned by household measured in terms of Tropical Livestock Unit (TLU). The number of livestock increase, the household expected to have more income sources.

Extension contact (EXN): It is a discrete variable measured by the number of contacts made in the year. It creates access to information and technical assistance on agricultural activities and adaptation methods through extension services.

Credit used (CRU): Availability of credit that household allows to purchase agricultural inputs such as fertilizer, improved crop varieties, construct irrigation facilities, create the opportunities to engage in different livestock production practices and expects to farm households to on non-agricultural activities to generate additional incomes. It measured the amount of birr to be borrowed from formal and informal financial institutions. The reason to use access to credit as dummy variable is due to similarity of amount of credit ranging from 5,000-15,000 Birr (which few of them only received above 10,000 birr)

Distance to market (DTM): It is a continuous variable and average kilometers from home of the households to the nearest market. It will expect positively for purchasing inputs and sell agricultural and non-agricultural households outputs. The more the closest the households have more advantages to engage him/herself to non-agricultural employment and diversify income sources.

Fertilizer (FER): The inputs used to support and improve the agricultural production and measured in terms of accessibility as dummy variables taking 1 if access and 0 otherwise. The amount of fertilizer in each household almost similar with range of 50-75kg (urea and dap) for limited crop type per season. To this end the researcher select

access to credit as dummy variables.

Pesticide (PES): The inputs used to support and improve the agricultural production and measured in terms of accessibility as dummy variables taking 1 if access and 0 otherwise.

Improved Seeds (ISD): The inputs used to support and improve the agricultural production and measured in terms of accessibility as dummy variables taking 1 if access and 0 otherwise. Due to similarity amount of improved seeds provide for households per crop type and land size. The researcher assumed to be perfect using as dummy variables in the model.

Access to information (ACI): It is a dummy variable and takes a value of 1 if there is access to modem information about market, agricultural technology and 0 otherwise. It measured by requested a household having mobile/radio or other means of information sources to access the information.

Agro-ecological features (AEG): It is dummy variable that takes a value of 1for woyina dega, 2 for Woyina dega and 3 for Kola. Farmers living in different agro-ecological zones make use of different income diversification strategies.

Distance from town (DFT): This variable is a continuous variable represented by walking time (in minute) from farmers' residence/home to their nearest town.

Household head membership (MBS): It is dummy variable that takes a value of 1 if participate as farms cooperative group and 0 other wise which expect to enhance agricultural and non-agricultural activities.

Dependency Ratio (DER): dependency ratio is defined as the number of persons in a population who are not economically active. It is a discrete variable measured the ratio of persons in the dependent age groups to those of the working ages provides a useful approximation to population dependency burden. The members of family below 15 years and above 65 years' age. The housed family members unable to participate in agricultural and non-agricultural activities measured in number as continues variable. Expected to have inverse relationship as dependency increase the tendency to increase income diversification decreased due to the fact that unproductive labor exists and unable to participate in income diversification activities.

Table 3.4: expected sign of independent variables

Variables	**nature of variables**	**Value**	**expected sign**
Age of the household head	Continuous	actual age in years	+ve/-ve
Sex of the household head	Dummy	1 if male o if female	+ve/-ve
Marital status of household head	Dummy	1 married, 0 unmarried	+ve
Family Size of household head	Continuous	household size	+ve/-ve
Number of Dependent family members	Continuous	Number of dependent family	-ve
Level of education	Continuous	years of schooling	+ve
Training service	Dummy	1 If access 0 otherwise	+ve
Distance to Town	Continuous	average k.m	+ve/-ve
distance to market	Continuous	walk-in hours	+ve/-ve
Access to information/having mobile, radio	Dummy	1 if access, 0 otherwise	+ve
Farm size	Continuous	hectares	+ve/-ve
Livestock size	Continuous	TLU	+ve
Membership in agricultural cooperatives	Dummy	1 if yes, 0 otherwise	+ve
Agro-ecology	Dummy	1.Dega,2 woyina-dega,3 kola	+ve/-ve
Extension contact	Continuous	frequency	+ve
amount of credit received	Continuous	Birr	+ve
access to Irrigation	Dummy	1 if access if not 0	+ve
Access to information	Dummy	1 if access if not 0	+ve
Use agricultural input/Fertilizer seeds	Continuous	1 if access if not 0	+ve/-ve
Use agricultural input/Improved seeds	Continuous	1 if access if not 0	+ve/-ve

3.2.6 Ethical Consideration

This study carried out with the approval from Addis Ababa University center for food security studies. The researcher informed for study participants as this study was conduct for academic purpose and Confidentiality of the household at the time of data collection was kept accordingly. Specially not taking their picture, name and their personal identity. It seems important to address ethical issues because I am using interviewing approach and giving direct quotations from the interviews.

CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATION

4.1 Descriptive Analysis

4.1.1 Socio-economic characteristics of rural households

This section described the results of socio-economic characteristics for rural households because of their effects on income diversification and food security. It also addressed the secondary sources of data related to the income diversification which were collected from Woreda agricultural and rural development office and Kebele Agricultural Development and Administration office to meet specific objective one. The socio-economic conditions of the study area presented and explained in table 4.1 and table 4.2 with categorical and continuous variables.

The distribution of the respondents by their gender showed that 86 percent were male and 14 percent were female. The majority of the respondents were males engaged indifferent livelihood activities in the study area. Male headed households have a tendency to diversify income than female headed households. The distribution of the respondents by their marital status is shown in Table 4.1 More than three quarters (86 percent) of the respondents were married, while 14 percent were single. The significance of marital status on agricultural production and income diversification activities can be explained in terms of the supply of agricultural family labor. It is expected that family labor would be more available where the household heads are married (Samuel, 2012). Marital status may influence the size of households as married households may have larger household sizes which may increase consumption expenditure thereby making them more prone to food insecurity.

Majority of the household have access to fertilizers ranging from 50 to 75kg urea and dap for their agricultural activities which accounts 62.2 percent, the remaining 38.8 percent of the households have no access to fertilizer. Access to credit have a positive effect to increase the agricultural productivities. More than half of the households have no credit access which accounts 51 percent of the respondents where as 49 percent of the respondents have credit access, this implies that the more access to credit the better to have income diversification. Irrigation enhance the agricultural productivities. Within the study area 44.4 percent of the households have access to irrigation which is found mostly in kola and Woyina Dega agro ecological zones, whereas 55.6 percent of the respondents

have no access to irrigation. Due to topography of the land almost all respondents live in Dega agro-ecology have no irrigation facilities. Regarding membership of agricultural cooperatives only 35.1 percent of the respondents have membership in agricultural cooperatives, most of them (64.9 percent) didn't have membership in agricultural cooperatives. Being a member of agricultural cooperative facilitate and make ease of access agricultural inputs and credit facilities. Only few of them benefited from membership of agricultural cooperatives.

Access to improved seeds, share cropping and access to information contribute to agricultural production and non-agricultural activities. This is due to the fact that households having access to improved seeds, market information and have additional land as share cropping enable the households to increase farm production and enhance food security. From key informant interview and FDG discussion, it is noted that income diversification is determined by the accessibility of different capital assets such as financial as credit, human capital as training and capacity building, infrastructure (road) and services such as extension service provision and technical assistant for households' agricultural and non-agricultural activities. This enables the household to have more flexibility in doing income diversification and improve food security as well as avoid yearly food aid dependency.

Table 4.1: Socio-economic characteristics of rural households with discrete variables)

Variables	**Number of HHs**	**Percentage**	**Variables**	**Number of HHs**	**Percentage**
Gender			Irrigation User		
Male	306	86	Non user	198	55.6
Female	50	14	User	158	44.4
Marital Status			Credit access		
Married	306	86	Non user	181	50.8
unmarried	50	14	User	175	49.2
Agricultural cooperative membership			Access to improved seeds		
No membership	231	64.9	No Access	218	61.2
Membership	125	35.1	Access	138	38.8
Access to fertilizer			Access to information		
User	138	38.8	Have no mobile, radio	194	54.5
Non-user	218	61.2	have mobile, radio	162	45.5

Sources: Survey result June, 2019

The results presented in Table 4.2 represent the socio-economic characteristics of respondents within the study area with Continues Variables. About 39.9 percent of the households were within 41-50 years, 37.6 percent were between 51-40 years while 12.4 percent were between 25-40 and 6.2 represent between 60-65. Only 3.9 percent were above 65 years of age. The mean age of the farmers was 50 years, implying that the households were in their productive age group. The distribution of the respondents by household size indicates that 69.4 percent had 4-6 members. Those with 7-9 members constituted 14.6 percent. Only 16 percent had household size which ranged between 1-3 members. The average household size was 5 which is near to the national average household size (5.5). The significance of household size in agriculture pivots that, the availability of labor for farm agricultural and non-agricultural activities determined by the size of the farm household.

The level of education responded by respondents indicate that 30.3 percent had no formal education, 29.8 percent had first cycle primary education (grade1 to 4), 32.9 percent had second cycle primary education (grade 5 to 8) and 6.7 percent had secondary education. The minimum and maximum level of education are 0 and grade 10 complete. Educational attainment is very important because it could lead to awareness of the possible advantages of modern farming techniques and diversification of households' incomes which in turn would enhance household food security. The majority of the households' have a farm size of between 0.25-0.50 which accounts 39.6 percent, size of 4-6 (accounts 69.4%), 16% of the households have 1-3 family and few of them had 7-8 (14.6%). The households had a minimum and maximum farm size of 0.25 and 1.25 hectare respectively with an average of 0.68hectars. This implies that limited land size with large family size aggravate food insecurity and tend to the farming households to engaged in non-agricultural activities and enhance food security within the study area.

As the cited by the sampled area households, 49.2% of them have accessed credit services from the Amhara Credit & Savings Institution (ACSI). The ACSI is helping households to engage in additional income generation activities, partially supported by World Bank fund. The key informants, however, noted that the selection of clients has been biased. They revealed that households prefer to borrow from informal financial sources such as a usurer because of the inconvenience of the bureaucracy.

Table 4.2: Households' socio-economic characteristics (Continues variables)

Socio-economic characteristics			
Variables	**Description**	**Number of HHs**	**Percentage**
Level of Education	No formal Education	161	45.2
	Grade 1-4	74	20.8
	Grade 5-8	108	30.3
	Grade 9-12	12	3.4
Age/years	25 to 40	44	12.4
	41 to 50	142	39.9
	51 to 60	134	37.6
	61 to 65	22	6.2
	>65	14	3.9
Number of household Size	1-3	57	16.0
	4-6	247	69.4
	7-8	52	14.6
Number of dependency	0	54	15.2
	0.14	171	48.0
	0.29	119	33.4
	0.43	12	3.4
Farm size (Hectare)	No farm land	0	0.0
	0.01-0.25	30	8.4
	0.26-0.50	141	39.6
	0.51-0.75	88	24.7
	0.76-1.00	86	24.2
	>1.00	11	3.1
Frequency of Extension contact	once per week	256	71.9
	twice per week	78	21.9
	Trice per week	7	2.0
	four per week	15	4.2
Livestock production/TLU	0.1-2.0	39	11.0
	2.01-3.0	140	39.3
	3.01-5.0	141	39.6
	5.01-8.0	29	8.1
	>8.01	7	2.0

Sources: Survey result, 2019

According to table 4.3 presented the level of diversification in the three agro-ecology of the study area. The Dega agro-ecology zone which consists of 21.63 % (no diversification), 9.27 % (low diversification) and 2.53 % (medium diversification) percent of the total sampled households respectively, while in the Woyina Dega agro-ecology zone 8.99%, (no diversification); 18.26 % (low); 10.67 % (medium) and 1 % (high) level of income diversification level. In case of Kolla Agro-ecology 5.06 % (no diversification); 12.64 % (low diversification); 9.55 % (medium diversification and 1.12% high level of diversification) respectively.

Table 4.3 Income diversification by agro-ecology of the study area

Income Diversification by Agro-ecology								
Agroecology	**No diversify**	**Percentage**	**Low diversify**	**Percentage**	**Medium Diversify**	**Percentage**	**High Diversify**	**Percentage**
Woinadega	32	8.99	65	18.26	38	10.67	1	0.28
Dega	77	21.63	33	9.27	9	2.53	0	0.00
Kolla	18	5.06	45	12.64	34	9.55	4	1.12

Sources: Survey result, 2019

4.1.2 Rural households' income sources

According to this study, income was categorized as income from farming (agricultural) activities and income from off/non-farm activities. Farming activities include crop and livestock r production while off/non-farm activities refer to handicraft, petty trading, rural micro and small scale enterprise, self-employment, agricultural and non-agricultural wages. Farm households in the study area are found to diversify their income activities, even though their livelihoods mainly depend on agriculture which consists of crop and livestock production or both. Non-farm farm activities have found to support the rural households. Table 4.4 shows the different income sources contribute to the overall household income. From the total sample size, on average the total income of rural households is 13,905 Ethiopian Birr (ETB) generated from a wide variety of income sources activities. The agricultural income sources accounts 51.3 percent for households who diversify their income (27.8 livestock & 23.5 crop respectively) while the total household receive income from non-agricultural activities contribute 49.7 percent of the total income. This implies that the more the household diversified their income the contribution of non-agricultural activities to the total income increased. Non-income diversified households' income sources mainly based on crop and livestock production which account 49.4 for livestock and 41.7 for crop with few (8.89 percent) income received from direct cash transfer and remittance. The sampled households in FGD indicated that "off-farm income fills the gap between production from subsistence farming and loss from disaster risks. Given the persistent trend of declining agricultural production in the study kebeles, the securing of supplementary sources of income is becoming a necessity".

The key informant discussion indicated households in the study kebeles are engaged on non-farm employment activities such as livestock trade, rural micro and small enterprise (handicrafts, petty trading), non-agricultural wage, and other off farm income sources. They noted that, unlike agricultural activities, income from off-farm employment opportunities is not easily degraded shocks such as drought. For this reason, households engaged in off-farm activities are more resilient and food secure than those that solely rely on subsistence agricultural practices.

Table 4.4: Composition of household Income (Ethiopian Birr, at 2018/2019)

Income sources	Household diversified		Household no-diversified	
	Mean	Share of income	Mean	Share of income
Average income	**18,700**	**100**	**9,110**	**100**
Livestock sells	5,200	27.8	4,500	49.40
Crop sells	4,400	23.5	3,800	41.71
Agricultural wage	3,450	18.4	-	-
Petty trading	850	4.5	-	-
Non-agricultural wage	1,800	9.6	-	-
Rural Micro and Small enterprise	2,100	11.2	-	-
Others/remittance/Cash Transfer	900	4.8	810	8.89

Sources: own survey, 2019 (multiple response is possible)

The study remarked as income diversification has a strong positive correlation with household income of rural households in the study area. The result strongly suggest that income diversification is crucial for the livelihoods of these households.

4.1.3 Rural households' degree of income diversification

The results in Table 4.5 show the degree of rural households' income diversification in the study area. Respondents with the most diversified income sources had the largest index and those with the least sources had the smallest index. It is found that, the intensity of income diversification falls between 0.01 and 0.60 diversify indexes. Households with no income diversification account 35.67 percent with a diversity index of $\leq$ 0.01. This implies that these farmers did not diversify their income sources. Households with two or more income sources had 64.33 percent with different income diversity index category (i.e. 0.02-0.25 (143), 0.26-0.50 (81) and >0.50 index only 5 households respectively. The mean income diversification index is 2.03. This implies that an average respondent in the study area had its members involved at least two types of income-generating activities simultaneously (from agricultural and non-agricultural activities). These activities were distributed between the two sectors, that is the farm and non-farm sectors identified in the study area.

Table 4.5: Rural households' degree of income diversification, 2018/2019

SID	Number of HHs	Percent	Diversification level	Average income (ETB)
≤ 0.01	127	35.67	No diversification	9,110
0.02 -0.25	143	40.17	Low diversification	14,350
0.26 -0.50	81	22.75	Medium diversification	14,875
> 0.50	5	1.40	High diversification	15,346

Source: survey result, 2019

4.1.5 Households' major constraints for income diversification

According to this study, lack of initial capital for agricultural and non-agricultural activities with high credit interest rate accounts 31.7 percent which is a major determinant factors for households' income diversification strategies. Limited land size for crop and livestock production which constitute (17.4 percent of the total respondents). The other determinant factors which hinder income diversification was recurrent drought. As responded by households' which account 17.7 percent of the total sampled households, drought limits agricultural productivity and reduce the amount of irrigation water. High price of agricultural inputs (fertilizer and improved seeds) covers 13.5 percent which have a significant factor for crop production of rural households, lack of rural infrastructure such as road and electrification covers and lack of training remaining covers the remaining 10.1 and 9.6 percent of total households'.

Table 4.6: Major factors affecting rural households' income diversification.

Factors	Number of HHS	Percent
Lack of infrastructure	36	10.1
High price of agricultural inputs	48	13.5
Lack of initial capital	55	15.4
High credit interest rate	58	16.3
Lack of cultivated and grazing land	62	17.4
Lack of training	34	9.6
Recurrent drought	63	17.7
Total	356	100.0

Sources: Survey Result, 2019 (multiple response possible)

As FGD member noted the issue of high credit interest rate, inadequate amount of credit provision leads them to borrow from informal credit sources to start non-agricultural activities such as handcraft, petty trading and small scale business activities. From key informant interview inadequate credit amount and high interest rate were not the only

reason to households to diversify their income rather lack of commitment, lack of rural credit collaterals and unwillingness to form groups, lack of business plan before taking credit which the households didn't know where to invest were the major obstacles to run off-farm activities in the Gubalafto Woreda, particularly within the study kebeles.

4.1.6 Food Security Status of the Respondents

Household Dietary Diversity Score (HDDS): The Household Diversity Score (HDDS) provides an approach to measuring household dietary diversity as a proxy measure of household food access. To better reflect a quality diet, the number of different food groups consumed is calculated. As shown on table 4.7. The dietary diversity scores ranged from 1 to 10 over 12 possible range of food groups with a mean DDS of 5.83 and Standard deviation of 4.59. The majority (67.13%) of the households fell within the medium DDS group, while 24.16% and 8.71% were in the low and high DDS groups, respectively. Dairy products, eggs, meat, poultry, fish, fruits were the least consumed food groups by the households, while cereals, vegetables, pulse/legumes, oils, roots and tubers crops, and sugar/honey were commonly consumed food groups.

Table 4.7: Mean dietary diversity of the different food groups.

Food groups	**Mean**	**Standard Deviation**
Cereals/Teff, Sorghum, Maize, Barley, wheat	0.95	0.21
Root and tubers/Potato, Sweet Potato, carrot and Turnips, a taproot	0.59	0.49
Vegetables/Cabbage, Salad, Green leafy vegetables	0.68	0.47
fruit/Banana, Mango, avocado, papaya	0.32	0.47
Meat, poultry	0.21	0.4
eggs	0.39	0.48
Fish	-	-
Pulses/legumes/Beans, peas, chickpea, soybean, vetch	0.96	0.21
Milk and milk products	0.41	0.49
Oil/oil seeds	0.67	0.47
Sugar/honey	0.58	0.5
Miscellaneous (Spices, condiments and beverages)	0.2	0.4
Total	5.83	4.59

Sources: Survey result, 2019

A Study held in IFPRI by Heady, D. & Ecker, O. (2012), the dietary diversification thresholds classified in to three (Low, medium and Good dietary diversification). Accordingly, the researcher found 24.16 % low, 67.13% medium and 8.71% good dietary diversity respectively.

Table 4.8: Distribution of the respondents by their food security status.

DDS threshold	DDS level	Number of HHs	Percentage
<4.5	Low dietary diversity	86	24.16
4.5-6	Medium dietary diversity	239	67.13
>6	Good dietary diversity	31	8.71
Total count		**356**	**100**

Sources: Survey result, 2019

Household Food Consumption Score (FCS): Table 4.9 shows the food consumption score of sampled households along with income diversification. A score of below 21 indicated that a household is expected NOT to eat at least staple and vegetables on a daily base and therefore considered to have poor food consumption. The threshold of 21 was selected based on one assumption of dietary patterns. The second threshold was set at 35. Between 21 and 35, households are assessed having borderline food consumption, while households that score above 35 are estimated having acceptable food consumption. Based on this base line target, 24.2 percent (86HHs), 43 percent (153HHs) and nearly 33 percent (117HHs) had poor, borderline and acceptable food consumption level.

Table 4.9: household food consumption score vs level of income diversification

Food consumption Score				**Level of Income Diversification**			
FCS threshold	**Number of HHs**	**Percent**	**classification**	**No diversification <0.01**	**Low 0.02-0.25**	**Medium 0.26-0.50**	**High >0.50**
0-21	86	24.2	poor	35	60	0	**0**
21.5-35	153	43.0	Borderline	0	78	75	**0**
>35	117	32.9	Acceptable	0	45	63	5
Total	**356**	**100**	**--**	35	**183**	**138**	**5**

Source: Survey result, 2019

As depicted on above table 4.9, the FCS shows that the majority of the households had a consumption level of borderline which falls on low and medium income diversification level.

Household Copping Strategy Index (CSI): The CSI has been shown to correlate well with other measures of food insecurity (such as dietary diversity, caloric intake, or nutritional outcomes) as well as with determinants of food security such as income, food budgets, and asset data. With measures of food frequency or dietary diversity, meal frequency, and caloric intake the correlations are largely negative (as would be expected, meaning that as the CSI increases the related variable decreases) and statistically significant. Similarly, the correlation is negative and significant with measures of assets, and correlates positively (as expected) with percent of expenditure devoted to food. This confirms earlier studies indicating that the CSI is significantly correlated with other measures of consumption adequacy, and equally well correlated with measures of assets and expenditure (Swindale, Anne, and Bilinsky, 2006). Each household has a coping strategy index which represents the weighted value of all nine behaviors.

Table 4.10 shows, households copping strategies taking 30 days coping behaviors for food security. Except Skip entire days without eating, gather wild food, hunt, or harvest immature crops, households practiced all copping strategies during shocks. The frequency severity value ranges from 0 to 4 where 0 (Never), 1 (Hardly at all, <1 time/week), 2 (once in a while;1-2times/week),3 (pretty offten;3-6 times/week), and 4 (always; every day). The severity of the CSI leads to put the copping mechanism in order.

Table 4.10: Rural households' frequency of coping behaviors for food insecurity.

Coping Strategies in the past 30 Days	Households Frequency of coping strategies				
	Never/week	1/Week	2/week	3-6/week	Rank
Selling woods/charcoal/timber	112	92	85	67	1
Selling assets/livestock including poultry	126	120	58	52	2
Borrow foods from friends/relatives	102	96	85	73	3
Rent their land for next season cultivation	185	65	42	72	4
Rely on less preferred and less expensive foods	108	114	80	54	5
Food purchase on credit	135	75	78	68	6
Sending household members to relatives	98	152	106	0	7
Reduce number of meals eaten in a day	173	75	56	52	8
Skip entire days without eating	356	0	0	0	9
Gather wild food, hunt, or harvest immature crops	356	0	0	0	9

Sources: survey result, 2019 (Multiple response is possible)

4.2 Econometric Analysis

In this part the researcher identifies the determinants of income diversification and its effect on rural households' food security status to meet specific objective two and three. Before running the ordered logistic regression model, it is necessary to conduct a Multicollinearity test. Thus, The VIF score for the main model without interaction is 2.24 which is significantly lower than 10 and we can conclude that there is no Multicollinearity in this estimation. The contingency coefficient was computed to see the degree of association among categorical variables. The larger value of Variance Inflation Factor (VIF), usually values exceeds 10 indicates a serious multi-collinearity problem (Guajarati, 2003). The Multicollinearity test results have no shown serious problems among the continuous and categorical independent variables (Appendix Table 4).

4.2.1 The determinants of income diversification

The factors that determine income diversification are presented in Table 4.11, the results showed that the average marginal effect of access to credit was positive and significant at 1 percent probability level. This means that credit received have a linear relationship with income diversification which indicate access to credit increases the level of income diversification by 2.9 percent (0.029353) marginal value effect. This result is similar to that reported by Beyene (2008); Demissie and Legesse (2013), Asnake, (2010) who noted that credit can reduce liquidity constraints and increase the capacity of households to start off-farm business. Ibrahim (2009) also noted that access to credit without any means of increasing farm size will cause the households to invest in non-farm activities in order to increase the rate of return to capital investment.

The average marginal effect (-0.0038461) obtained for household size was significant but negative at 5 percent level. This implies that keeping other variables constant, an increase in household size by one unit have a probability decrease in income diversification by 0.015. This result supported by Desta (2010) on his study assessed determinants of household income diversification indicate that family size was negatively related to household income diversification. However, other empirical studies by (Zerihun et al, 2015), Tadele and Ayele (2012), Woldenhanna, Oskam (2001), as noted on their study, an increase in household size increase labor availability which makes easier for the households to let some members engage in off-farm and others income generating

activities. Reasons for the negative sign coefficient for household size on this study shows that there is unproductive labor force e household with accounts an average dependency ration of 0.20 approximately which implies 2 members of the household being under 15 years or greater than 65 years old.

The average marginal effect with value of (0.048) for training service was positive and significant at 1 percent probability level. The implication indicated that keeping all other variables constant or their value near to mean, households' access to training had a tendency to increase income diversification by 4.8% as compared those who didn't took training on agricultural production and income diversification activities. Providing capacity building for rural households on agricultural and non-agricultural activities acquired skill and technical knowhow on better and modern techniques of farming as well as income-generating activities. This result is similar with (Agyeman (2014) and Dimova, and Sen, (2010) studies indicated as farm households require government and private sector support to increase the gains made in participating in various diversification strategies through training in order to raise their living standards.

As human capital theory predicts, the best investment of all is the one made in people and therefore, providing technical training, encouraging educational attainment may imply a larger set of employment opportunities and specifically in a rural context a better awareness of the full potential of the new agricultural technology and associated agricultural practices winding the opportunity of participating households' in non-agricultural activities. The coefficient of access to training in table 4.11 with ordered logistic regression model showed that, having training access rather than formal education rises, the probability of being households to diversify income increase with statistically significant.

Theoretically it is predicted that gender affects off farm income diversification due to culturally defined roles, social mobility limitations and differential ownership of/access to assets between male and female (Brehanu, 2007). In this study, it is found that gender is statically significant with negative coefficient. This implies that male households' more probable to participate in agricultural activities rather in participating in local off farm activities while female households tend to more likely to participate in non-agricultural activities (i.e. the likelihood of male households' participation in non-farm activities is found to decrease by 0.2 percent) which is similar to the study by Mulatu et

al (2017). Keeping other things constant the average marginal effect with value of (-0.0193482) distance to market from household livelihood activities had a negative effect for income diversification of rural households at 1 percent probability level. This implies that an increase the market distance by one unit leads to decease the chance of income diversification. In other words, the closeness to market centers creates access to additional income by providing non-farm employment opportunities and easy access to inputs and transportation of farm outputs. It is expected that households nearer to market center have better chance to participate in household income diversification than others. Similar to this result, Lesego (2017)) stated that market distance and non/off farm diversification had positive and significant relationship because residing nearer to the market enables farm households to engage in non-farm activities (like petty trading and shop keeping).

The results showed that the average marginal effect for education was positive but not significant at 5 percent level of probability. This result implies that each additional year of schooling increases income diversification by a probability of 0.307 (30.7%). Education enhances the potential of respondents and makes them assessed available opportunities with little or no stress. The positive coefficient of education agrees with results of studies earlier reported by Minot et al. (2006) and Zerihun (2017) indicated as education gives individuals access to a number of different economic activities, either as a formal requirement for wage earning jobs or because it helps them in setting up and managing their own small businesses, however the study revealed that the majority of rural households didn't got to attained formal education, due to lack of schools nearby their villages/homestead. Use of improved agricultural input is significantly related to increasing agricultural productivity. in this study it is found that the average marginal effects of access to fertilizer was negative value **(**-0.0086214**)** which implies, as increase the accessibility of fertilizer within given households decrease in participating off-farm activities due to the fact that households tend to engaged on agricultural activities to maximize their production. This is proved on this study which revealed that uses of fertilizer significant at 1% level implies decrease in participating non-agricultural income sources. The use of improved agricultural input increase the productivity of a given land. Improvement in productivity ultimately leads to improvement income, even if not encourage to engaged on non-farm activities.

The estimated average marginal probability effect of access to information was 0.0141747 in the ordered logistic regression model implies that an increase in chance of access to information by one (unit) leads to an approximately estimated increase of income diversification by 1.4 percentage points.

The coefficients obtained for education, age, farm size, membership of cooperatives were not significantly related to income diversification on this study. The non-significance of membership of cooperatives maybe attributed to the fact that about half of the respondents did not belong to cooperative associations. In general, based on the findings of this study, the researcher summarized as there is significant relationship between income diversification and socio-economic characteristics of rural households taking other thing constant.

Table 4.11: Average marginal effect estimation on the determinants of income diversification

Independent variables|	dy/dx.	Std. Err	Z	P>|Z|	[95% Conf. Interval]	
Education	0.00057	.0396221	1.02	0.307	-.0371916	.118124
Gender	-0.0134832	.3564675	-2.36	**0.018***	-1.538443	-.1411158
Age	0.0001881	.0130744	1.08	0.282	-.0115659	.0396849
Distance from town	-0.0012414	.0669784	0.75	0.453	-.0810665	.1814841
Family Size	-0.0038461	.1030307	-2.44	**0.015****	-.4533742	-.049501
Farm Size	-0.0034837	.5535008	-0.29	0.771	-1.246021	.923662
Fertilizer	-0.0086214	.304492	-2.70	**0.007***	-1.418872	-.2252849
Irrigation	.4156152	.354296	1.17	0.241	-.2787923	1.110023
Credit use	0.0293537	.2508017	8.83	**0.000***	1.722271	2.705396
Training	0.0481981	.3851354	9.06	**0.000***	2.734901	4.244604
Access to information	0.0141747	.2745419	3.82	**0.000***	.5116252	1.58781
Extension	.1829423	.1770279	1.03	0.301	-.164026	.5299105
Distance to market	-0.0193482	.5860744	-3.28	**0.001***	-3.070297	-.7729277
Tropical Livestock Unit	0.0016679	.069375	1.33	0.185	-.0439523	.2279929

** and ** indicate statistically significant at 1% and 5% of probability,*

4.2.2 Effects of income diversification on households' food security

The results presented in Table 4.12 revealed that there is significant relationship between income diversification and food security status of the rural households. The coefficient obtained for diversification index between (0.2-0.25) was positive (.0872445) and significant at 5 percent level of probability. This implied that income diversification

increases, food security status of the respondents also increases in reference to household with no diversification category which is a diversification index of <0.01. The coefficient for diversify index between (0.26-0.50) as also positive (.1032295) and statistically significant at 5 percent probability. This indicates that an increase the level of income sources would increase the food security status of the households with increased diversity index of category one. Finally, the coefficient for diversity index >0.50 was also have positive coefficient (.1806973) but insignificant at 5 percent level of probability. Income diversification has been reported to cause a significant increase in total household income, which would, in turn, increase household food security status. This result is similar to that of Agboola *et al.* (2008) and Bernard *et al* (2014) who found that food security among farming households was influenced by income diversification strategies. They found the estimated coefficient of income diversification was positive and significant at 5 percent level of probability which implied that as income diversification increases, food security status of the farmers also increases. This is because individuals that derived their income from a combination of agricultural production and off- farm activities were food secure due to the fact that, the food security status of households that diversified their income have better dietary diversity than households not diversify their income and who engaged in one income sources. Other studies Tithy *et al* (2016) noted as diversification of income sources has been put forward as one of the strategies that households employ to minimize household income variability and ensure a minimum level of income diversification which reduces poverty and enhances the food security of rural households. Based on the findings of this study, the researcher testify as income diversification has effect on food security status of rural households in the study area.

Table 4.12: Effect of income diversification on households' food security status

SID	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
0.02-0.25	.0872445	.0400449	2.18	0.029*	.0087579	.1657311
0.26-0.50	.1032295	.0433899	2.38	0.017*	.0181869	.188272
>0.50	.1806973	.1765682	1.02	0.306	-.16537	.5267646
_cons	1.682179	.113297	14.85	0.000	1.460121	1.904237

**Indicates significant at 5% probability level.*

Sources: survey result, 2019

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Farming households in *Gubalafto* Woreda are increasingly seeking alternative sources of income by participating in off-farm income activities. The reasons for this include the need to increase family income to guarantee sufficient livelihood, the desire to manage agricultural production risks in the face of climate change and the need to invest on farm/off-farm business in the absence of a functioning credit market. The agricultural production motive is particularly important for poor households. This is because lack of liquidity and inadequate access to credit has been identified as among the most pressing constraints to improved agricultural productivity in the study area.

Empirically, most households drive their annual income source from agricultural activities and non-agricultural income sources activities. Results of the econometric model showed that seven out of 14 variables were statistically significant at $P<0.01$ and $P<0.05$ which influenced income diversification. Access to credit, access to information, training service and distance (proximate) to market were statistically significant factors at 1% and 5% level of probability to increase income diversification. Household size, gender (being male) and access to agricultural input (fertilizer) have no positive contributions to income diversification sources rather increasing agricultural production only. Based on the FGD and KII members, Inadequate availability of credit, high rural credit interest rate, lack of working capital and low wage payments, recurrent drought, inadequate training service and limited land size are major factors that influence households' income diversification status.

The income diversification and food security status of the respondents were positively and significantly related, meaning that as income diversification increases, households' dietary diversity increases and food security status of the respondents also improved. This study shows that income diversification has a positive contribution to food security associated with higher incomes and food consumptions. Respondents with the most diversified income sources had the largest index and those with the least sources had the smallest index. It is found that, the intensity of income diversification falls between 0.01 and 0.60 diversify indexes with the mean income diversification index of 2.03. The mean index shows that; the study area has limited income diversification trend due to various

constraints as indicated above. Generally, the involvement of most farming households in income diversification activities for sustainable rural livelihood cannot be over emphasized. Diversification is therefore seen as a way to secure income and increase food security. It is obvious that most rural households in the study area are involved in off-farm activities as a way of supplementing income from agriculture hence diversifying their income sources and improving their food security.

5.2 Recommendations

Based on the findings of the study, the following policy implications or interventions are suggested to the study area that could be helpful in addressing income diversification and food security issues.

- There is a need for Gubalafto Woreda agricultural and rural development office to pay attention to agricultural extension programs, through the recruitment and training of adequate extension workers to meet the needs of farmers.
- Addressing the entire rural space and looking beyond farming to include off-farm income opportunities is the responsibility of Woreda Administrative office particularly the coordination between Woreda food security, rural micro and small enterprise and Woreda Disaster risk and preparedness office.
- Addressing rural credit demand would enhance in participating off-farm/non-agricultural activities. This could be a responsibility of Gubalafto Woreda rural credit facilitation office in coordination with Amhara credit and saving institutions.
- Promoting farmers' agricultural cooperative also enhance rural households' to participate off-farm business activities. Hence Gubalafto Woreda Agricultural cooperative support office could be responsible to provide training and consult rural households to form new Agricultural cooperative union or being membership in the existing unions.
- Diversifying agriculture and non- agricultural employment opportunity would have positive impact to food security status of the rural households in the study area, thus there is a need for the provision of rural infrastructure such as rural electricity, roads, markets, water supply, health and telecommunication as well as improvement in financial markets so as to enhance farmers' capacity to generate income from more sources.
- The Woreda Food security office and Woreda micro and small enterprise support office, disaster prevention and preparedness office and other aligned local/Kebele administration may need to promote programs and awareness on how households can

diversify their livelihood strategies as a way of coping with economic constraints in the area.

- Strengthening both formal and informal education and vocational training should be promoted to increase rural household's participation in more viable livelihood options and offer better prospects for improving their livelihood. Develop and promote rural micro and small-scale enterprises relating to households' skill and market opportunities.
- Increase the productivity of crops by using fertilizer and compost and Integrated Pest Management System.
- Stakeholders should motivate farm households to engage in multiple livelihood sources because this would solve household income shortfall and critical land constraints in the area.
- Strengthening rural organizations, helps not only to preserve the values of a particular society but also to facilitate livelihood diversification and hence improve food security.
- Cultivated land is under heavy population pressure, soil fertility is eroded, and drought is the common phenomenon in the study area. As a result, the current livelihood could not ensure diversified income sources and secure food security as well as the wellbeing of households. Therefore, interventions should be shifted from development or emergency assistance into livelihood interventions. Promotion of income generating activities for rural households especially those who are in low income diversification score is needed.
- Institutional coordination unit should be put in place for different interventions on income diversification and food security.
- Livelihood and other agriculture extension programs by office of agriculture; micro and small scale enterprise activities office of Woreda trade and industry. Therefore, there should be adequate institutional mechanism to coordinate these income diversification and food security interventions at a Woreda and Kebele level.

Generally, the researcher recommend as the present study has extensively explored the issues of rural food security at household level empirically. But more research is needed to explore the issues of income diversification aligned with rural food security from social, political, economic and other perspectives both quantitatively and qualitatively. Particularly studies on livelihood diversification with repeated recurrent drought area is important.

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APPENDICES

Appendix Table 1: SURVEY QUESTIONNAIRE:

ADDIS ABABA UNIVERSITY

COLLEGE OF DEVELOPMENT STUDIES

CENTER FOR FOOD SECURITY STUDIES

Household Survey Questionnaire

Dear respondent, this is an academic survey aiming to fulfill Masters of Science in Food Security and development Studies with research title on "***Determinants of Income Diversification and Its Implication to Rural Households Food Security in Gubalafto Woreda Northern Ethiopia". t***he surveys mainly cover some relevant aspects of your situation including: Socioeconomic status, agricultural and non-agricultural activities, agricultural production, expenditure, saving, consumptions and food security status. Please respond the questions honestly and in accordance with the actual situation of your household and thoughts, assisting the enumerator sincerely to complete the questionnaire. I will strictly follow to keep your personal information confidentially.

Thank you for your cooperation!

Household Survey questionnaire on "Determinants of income diversification and its Implication to households' Food Security"

I. General Information

1. Questionnaire number……
1. Date of interview……....
2. Name of enumerator……
3. Name of Keble ……
4. Agro-ecology 1. Woyina Dega 2. Dega 3. Kolla

II. Demographic characteristics

1. Age of household head……
2. Sex of household head 1. Male, 0 female
3. Education level of household head……
4. Marital statuses of household head……
   1. Married
   0. Single
5. Family Size……
6. Number of children under 15years' age…….
7. Number of household members above 65 years' age……

III. Land ownership, Access and Agricultural activities

1. Do you (or any other member of your household) own any land? .....
   1. Yes 2. No
2. If yes, how many hectare of land do you have your own.....?
3. Do you (or any other member of your household) own any sharecropping land? .....
   1. Yes 2. No
4. If yes, how many hectare of land do you cultivate as share cropping.....?
5. Do you have access to use fertilizer? 1. Yes, 0. No
6. If yes, how much k.g urea and dap do you use for the last production year?
7. Amount of fertilizer used for the last production year urea…….....k. g, Dap……k. g,
   3. Price of fertilizer (Birr)…….?
8. Do you have access to pesticide? 1. Yes, 0. No, if yes Price per unit (Birr)……...?
9. Do you use compost/organic manure as fertilizer? 1.yes, No
10. Own Agricultural labor……...? Hired agricultural labor……?
11. Do you have access to irrigation? 1. Yes, 0. No

12. Do you have access to training on Agricultural production, Income diversification and business activities/?
13. How many times do you get advice from development agents per week?
14. For each crop grown, how much was harvested and what did you do with the harvest during the last two production season prior to the survey? (Crop Production by rain fed and irrigation)

Crop type	**Bega (Kgs)**					**Mehare (Kgs)**					**Irrigation**
	Qt. prod	**Qt. Sold**	**price/un**	**Qt. Cond**	**Qt. resd**	**Qt. produce**	**Qt. Sold**	**price/un.**	**Qt. Cond**	**Qt. resd**	**Amount of producti**
Maize											
Sorghum											
Barley											
Wheat											
Teff											
Millet											
chickpea											
Oil crops/Noug, Sesame, Sun flower											
Bean											
Paean											
Tomatoes											
Garlic											
Potato											
Onion											
Cabbages											
Salad											
Pepper											
Perennial Crops											
Others (Lists)											

IV. Household livestock Asset

1. Did you keep any of the stock listed below for the last one-year prior the survey... 1.yes, 2. No……?
2. *If yes, please tell us details for each stock kept, expenditure for livestock production*

2010/2011 E.C					
Livestock Type	**Number of Units**	**expenditure for veterinary treatment**	**Expenditure for feed purchase**	**Unit Sold**	**Unit price (ETB)**
Oxen					
Bulls					
Cows					
Heifers					
Calves					
Sheep					
Goats					
Donkeys					
Mules					
Horses					
Camels					
Poultry					
Bee hives					

3. What are the major determinant factors for your crop and livestock productivity?
   (a)…….
   (b)…….
   (c)……....
   (d)…….
4. Annual livestock and livestock products sells revenue

2010/2011 E.C			
Livestock/Livestock products	**Unit**	**Amount sold**	**Unit price**
Butter	K.gs		
Milk	litter		
Eggs	number		
Poultry/Chicken	number		
shoats/sheep and goat	number		
Honey and wax	k.gs		
Hide and skin			
Others(list)			

V. Household non-agricultural activities

1. Please tick below as per indicated request

2010/2011 E.C	
Non-agricultural activities	Income/ETB/Year
Agricultural wage	
Non-agricultural wage	
Petty trading	
Self-employment	
others (please specify)	

2. Estimated income from below sources from the last one years
   a. Remittance 2010/2011 E.C/ETB…. …..……?
   b. Cash transfer 2010/2011 E.C/ETB……?
3. How much you save from your total agricultural and non-agricultural income? ETB.....

4. For Items below tick the appropriate box regarding reason for engaging non Agricultural Activities.

	Reason	Yes	No
a	Recurrent drought		
b	Mostly to generate cash income for household basics i.e food and clothes		
c	Unstable return from agriculture		
d	Use of economic capacity		
e	lack of land for farming		
f	lack of grazing lands for livestock production		
g	Respond in employment potential opportunities		
h	High wage in nonfarm sector		
i	The credit market is efficient		
j	Low farm productivity		
k	Lack of capital for farms i.e. inputs		
l	Small farm size		
m	The market is favorable		

5. In your view what is the main constraint of non-agricultural business activities?

a.……...
b……...
c……...
d……

VI. Social Capital

1. Fill appropriately on below listed group participations /membership you belong to

S.N	Membership	yes	No
1	Agricultural cooperatives		
2	Religious Mehaber		
3	Credit and thrift		
4	Model farmers		
5	Ekub/Edir		
6	Traditional Wonfel/Jigie/Debo		

VII. Food Security status of households

1. Please fill below food consumption score along with meal frequency

S. N	Food Groups	Meal Frequency						
		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1.1	Cereal Grains (lists)							
1.2	Legumes (lists)							
1.3	Roots and tuber crops (lists)							
1.4	Meat, Milk eggs and Poultry							
1.5	Vegetables (lists)							
1.6	Fruits (lists)							
1.7	Others (please specify)							

2. Household Dietary diversification questionnaire/with 24recall periods

	Food groups	yes	No	Count
1	Cereals/Teff, Sorghum, Maize, Barley, wheat			
2	Pulses/legumes/nuts			
3	Vegetables/Cabbage, Salad, Green salad			
4	Oil/Fats			
5	Root and tubers/Potato, Sweet Potato, carrot and Turnips, a taproot			
6	Sugar/honey			
7	Milk and milk products			
8	Eggs			
9	Fruits/Banana, Mango, Avocado, Pineapple			
10	Meat, poultry			
11	Fish			
12	Miscellaneous (condiments)			
13	Do you eat outside your home			
14	if yes, what type of food items do you eat?			

3. During food deficit which of the following ways has your household used to get food for the last 30 days?

	Coping Strategies	Frequency	Severity	Score
1	Reduce number of meals eaten in a day			
2	Food purchase on credit			
3	Skip entire days without eating			
4	Borrow foods from friends/relatives			
5	Selling woods/charcoal/timber			
6	Sending household members to relatives			
7	Gather wild food, hunt, or harvest immature crops			
8	Rely on less preferred and less expensive foods			
9	Seek employment or any kind of income source.			

4. what are the causes of food insecurity at your household?

a. …….
b. …….
c. ……
d. ……
e. ……
f. ……

VIII. Household Expenditure, Saving and credit Access

1. What is your estimated expenditure on the household income per month?

2010/2011 E.C

a	Expenditure item	Amount spent (birr/month)
b	School fees for children	
c	Land taxes	
d	health insurance	
f	Clothes	
g	Kerosene/rural energy	
h	Food item purchase	
i	Others (please specify)	

2. How many birr do you take from credit…….?
3. In what purpose do you borrow the credit?

a. ……..
b. ……
c. …….
d. ……..

IX. Household market and Information Access

1. Do you have market access to sell agricultural and non-agricultural business? 1. yes...., 0. No…...?
2. Distance from market……in km?
3. In what type of transportation system used to transport your product to market?.....
4. Do you have radio at your home? 1. Yes, 0. No…….
5. Do you have mobile access? 1.Yes, 0. No……
6. If yes for what purpose do you use……....?

Appendix Table 2: Checklist for key informant Interview

General Information

kebeles…….

1. What do you explain the socioeconomic and living condition of the study area?
2. What are the factors that affect to perform agricultural and non-agricultural activities?
3. What are the coping strategies taken by households to cope with food insecurity situation?
4. What type of Agricultural and non-agricultural activities have been performing in the area?
5. What are the interventions providing by local government and NGOs to overcome the issue of income diversification?
6. What are your suggestions on how to cope with the problem?
7. What are your opinions on the effect of income diversification on food security?
8. What do you consider to be important means of Income diversification in particular and improving food security in general?

Appendix Table 3: Checklist for focus group discussion (FGD)

Kebele name …….

Number of groups…….

1. What do you understand by the term Income Diversification?
2. Does the village have Diversified trend?
3. If yes, what is the reason to Income diversification?
4. Under normal circumstances how many meals do households take per day in your village?
5. What are the causes of to diversify income in your village?
6. What are the interventions providing by local government to overcome the issue of income diversification?
7. What are the coping strategies taken by households to cope with the situation?
8. What are your suggestions on how to cope with the problem?
9. How much of the income from agricultural and non-agricultural incomes are used for household food security?
10. What are your opinions on the effect of income diversification on food security?
11. What do you consider to be important means of Income diversification in particular and improving food security in general?

Appendix Table 4: Multicollinearity Test

Variable	VIF	1/VIF
Marital status	7.55	0.132484
Gender	7.50	0.133370
Irrigation	1.84	0.544302
Distance to Market	1.35	0.743193
Extension Contact	1.32	0.757084
Agro-ecology	1.31	0.764323
Fertilizer	1.30	0.770004
Pesticide	1.26	0.796115
Tropical Livestock unit	1.21	0.824857
Farm Size	1.16	0.863155
Improved seeds	1.16	0.863657
Family Size	1.15	0.868162
Age of households	1.12	0.889575
Education	1.05	0.953883

Appendix Table 5: Model Specification (Link Test)

Model: Ordered logistic regression,

Log pseudo likelihood = -239.99342

Number of obs = 356, Wald chi2 (13) = 179.82,

Prob > chi^2 =0.0000,

Pseudo R^2 =0.4039

Appendix Table 6: estimation of ordered logistic region model

Independent variables|	Coef..	Std. Err	Z	P>|Z|	[95% Conf.	Interval]
Education	.0404662	.0396221	1.02	0.307	-.0371916	.118124
Gender (Male)	-.8397792	.3564675	-2.36	0.018*	-1.538443	-.1411158
Age	.0140595	.0130744	1.08	0.282	-.0115659	.0396849
Distance from town	.0502088	.0669784	0.75	0.453	-.0810665	.1814841
Family Size	-.2514376	.1030307	-2.44	0.015**	-.4533742	-.049501
Farm Size	-.1611797	.5535008	-0.29	0.771	-1.246021	.923662
Fertilizer	-.8220783	.304492	-2.70	0.007*	-1.418872	-.2252849
Irrigation	.4156152	.354296	1.17	0.241	-.2787923	1.110023
Credit use	2.213834	.2508017	8.83	0.000*	1.722271	2.705396
Training	3.489753	.3851354	9.06	0.000*	2.734901	4.244604
Access to information	1.049717	.2745419	3.82	0.000*	.5116252	1.58781
Extension	.1829423	.1770279	1.03	0.301	-.164026	.5299105
Distance to market	-1.921612	.5860744	-3.28	0.001*	-3.070297	-.7729277
Tropical Livestock Unit	.0920203	.069375	1.33	0.185	-.0439523	.2279929

*and ** significant variables with 0.01 and 0.05% level of probability

Appendix Table 7: effect of income diversification on food security estimation

. poison Dietary divscore, r

Iteration 0: log pseudo likelihood = -738.42088

Iteration 1: log pseudo likelihood = -738.42088

Poisson regression model

Number of obs = 356

Wald $chi^2(11)$ = 26.76

Prob > chi^2 = 0.0050

Log pseudo likelihood = -738.42088

Pseudo R^2 = 0.0073

SID	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
0.02-0.25	.0872445	.0400449	2.18	0.029*	.0087579	.1657311
0.26-0.50	.1032295	.0433899	2.38	0.017*	.0181869	.188272
>0.50	.1806973	.1765682	1.02	0.306	-.16537	.5267646
_cons	1.682179	.113297	14.85	0.000	1.460121	1.904237

Poison regression model, Pseudo likelihood = -738. 42088, Wald chi^2 (10) =26.76, Prob > chi^2 = 0.0050, Pseudo R^2 = 0.0073

Appendix Table 8: Food Items, Food Group and Weight applied

No	Food groups	Weight	Justification
1	Cereals	2	Energy dense/usually eaten in larger quantities, protein content lower and poorer quality (PER17 less) than legumes, micro-nutrients (bound by phytates).
2	Pulses	3	Energy dense, high amounts of protein but of lower quality (PER less) than meats, micro-nutrients (inhibited by phytates), low fat
3	Vegetables	1	Low energy, low protein, no fat, micro-nutrients
4	Fruits	1	Low energy, low protein, no fat, micro-nutrients
5	Meat and fish	4	Highest quality protein, easily absorbable micronutrients (no phytates), energy dense, fat. Even when consumed in small quantities, improvements to the quality of diet are large.
6	Milk	4	Highest quality protein, micro-nutrients, vitamin A, energy. However, milk could be consumed only in very small amounts and should then be treated as condiment and therefore re-classification in such cases is needed.
7	Sugar	0.5	Empty calories. Usually consumed in small quantities.
8	Oil	0.5	Energy dense but usually no other micro-nutrients. Usually consumed in small quantities
9	Condiments	0	These foods are by definition eaten in very small quantities and not considered to have an important impact on overall diet.

Appendix Table 9: Tropical Livestock Unit (TLU) equivalent conversion factors

Livestock Type	Conversion factors
Cattle	0.7
Sheep	0.1
Goats	0.1
Donkeys	0.7
Camel	1.0
Mule	1.0
Horse	1.0
Chicken	0.01

Sources: Taylor and Turner (2000)