COLLEGE OF DEVELOPMENT STUDIES
CENTER FOR FOOD SECURITY STUDIES

THE NEXUS BETWEEN HOUSEHOLD FOOD SECURITY AND NUTRITIONAL STATUS OF CHILDREN UNDER FIVE IN GELAN TOWN, OROMIA REGION, ETHIOPIA

BY

REDWAN MOHAMMED

OCTOBER, 2020

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DECLARATION

First, I declare that this thesis is the result of my original work and that all sources or materials used for this thesis have been appropriately acknowledged. This thesis is submitted in partial fulfillment of the requirements for Master's degree at Addis Ababa University. I confidently speak out that this thesis has not been submitted to any other institution and anywhere for the award of an academic degree, diploma, or certificate.

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REDWAN MOHAMMED NEJIB
October, 2020
Addis Ababa

APPROVAL

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This is to certify that the thesis entitled by Redwan Mohammed, entitled: "The Nexus between Household Food Security and Nutrition Status of Children under five in Gelan Town, Oromia region, Ethiopia", and submitted in partial fulfillment of the requirements for the Degree of Master in Food Security and Development Studies complies with the regulation of the University and meets the accepted standards with respect to originality and quality.

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Abstract

This study aimed at investigating the nexus between household food security and nutrition status of children under five in Gelan town, Oromia region, Ethiopia. A total of 100 mothers of under five children were selected using stratified random sampling technique from three kebeles. Data were collected using structured questionnaires and anthropometry. Household food insecurity access scale (HFIAS) and household diatery diversity score (HDDS) were used to investigate food security status of households. Likewise, anthropometric indices height for age (HFA), weight for height (WFH) and weight for age (WFA) were used to determine the nutritional status of under five children. Descriptive and inferential statistics as well as multivariable logistic regression model were used to determine the association between household food security and nutritional status of under- five children in the study area. The result indicated 8.2% of households were food secure of which 29.05 % were severely food insecure while 27.86 % and 34.87% mild and moderately food insecure respectively. Majority of the households have medium diatery diversity score (55%) while 24 % and 21 %of the households have high and low dietary diversity score, respectively. Underweight prevalence was found to be 13% in the kebeles among under-five children. Similarly, wasting prevalence was 4% and stunting prevalence was 7% in the kebeles among under-five children. Household dietary diversity, monthly income and household's food security access scale showed positive relationship with normal underweight, normal stunt and normal wasting. Whereas, mother's occupation, farm land area, home garden, education level of household head, breast feed, marital status, living home owner and household head sex showed negative relationship with normal underweight, normal stunt and normal wasting among study area. Monthly income shows positive relation with all the nutritional status indicators. It is recommended that there is a need for communities to stand-in activities that increase household income, which will in turn improve expenditure on child care, and implications child nutritional status for better food and nutritional security in Gelan town selected kebeles.

Keywords: Food Security, Nutritional Status, Under Five Children, Anthropometric Indices, Dietary Diversity, Gelan Town, oromia, Ethiopia

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ABBREVIATIONS

ADLI	Agricultural Development-Led Industrialization
CSA	Central Statistical Authority
DFID	Department for International Development
FAO	Food and Agricultural Organization
FGD	Focus Group Discussion
FSS	Food Security Strategies
IFPRI	International Food Policy Research Institute
HDDS	Household Dietary Diversity Score
NACS	Nutrition Assessment, Counseling, and Support
NDRMC	National Disaster Risk Management Commission
NGOS	Non-Governmental Organizations
PSNP	Productive Safety Net Program
UNICEF	United Nations Children's Fund
WNS	World Nutrition Situation
WHO	World Health Organization

CHAPTER ONE: INTRODUCTION

1.1. Background of the Study

Since the 1970's, food security developed a prominent matter and became a worldwide concern (Maxwell and Frankenberg, 1992) especially in the developing nations. At the World Summit for Children (WSC) in New York (1990) and at the World Nutrition Situation (WNS) held in Rome (1992) concluded that consumption of foods reference to cover the nutritional needs of all individuals in the household these requirements cover energy, protein, and other micro nutrients. Household food security depends on access to safe food to sufficient quality and quantity in the households, intra-household distribution of adequate food, health status of individual household members, sanitation, and health care to determine the nutritional status of individual household members (UNICEF, 1997; UNICEF, 1998). Ensuring household food security is an important goal included in the World Declaration on Nutrition and Sustainable development goal Action for eradicating malnutrition. Many nations have joined this program to ensure that every man, woman and child would be free from hunger and malnutrition.

Malnutrition is linked through the life span process, with under nutrition in fetal and early childhood life contributing to both instant and long-term health problems such as stunted physical growth, coronary heart disease, stroke, diabetes, and abdominal obesity, as well as economic costs due to loss of human capital (Black et al., 2008). Malnutrition during childhood is the outcome of insufficient food intake, diarrhea and other infections, lack of sanitation, and low parental education (Birara et al., 2014). Poor diets and disease are due to food insecurity, inadequate maternal and childcare, and poor health services and environment (WHO, 2009). These factors cause assess able adverse effects on body function and clinical outcome. This problem leads to most of the anthropometric deficits found among children under a five age in the emerging countries. Despite existing interventions to address child malnutrition, it is still a major global public health problem (Akombi et al, 2017).

Child malnutrition is a fundamental cause for almost half (45%) of child deaths, particularly in low socioeconomic groups of developing countries (Black et al., 2013). Maternal and child malnutrition contributes to 45% of deaths in children under five (Black et al., 2008). Child malnutrition influences cognitive function and low socioeconomic groups contributes to poverty through obstructing individuals' ability to lead productive lives in addition, it is estimated that

more than one third of under-five deaths are attributable to under nutrition (Liu et al, 2012; Black et al., 2008).

Food insecurity is a global public health problem. Household food insecurity is the major issue of affected under-five children, around three hundred Thousand deaths every year whether directly or indirectly, due to insufficient food consumption and poor diet qualities, it is also affected for above half of all deaths among under five children in Sub-Saharan Africa (Frelat et al, 2016). It is estimated that the prevalence of food-insecure individuals in the area will reach 17 million by the year 2021 (Wuyeh et al., 2019). Inadequate balanced diet may result in low cognitive function, impaired physical retardation and reduced low socioeconomic productivity among children under five years throughout their life span.

Based on FAO and its associate report, 821.6 million people in the World is affected by severe food insecurity in the year 2018. The majority of people who are suffering from severe food insecurity to live in Africa put to be 256.1 million. Among others, the number of food insecure and child malnutrition people living in sub-Saharan Africa is reported to be around 239.1 million (FAO et al., 2019). Based on the above figure, the number has been increasing steadily in Africa, where it reached almost 260 million people in 2018, with more than 90 percent living in sub-Saharan Africa.

Globally in 2018, an estimated 149 million children under-age 5 were stunted and 49 million children were wasted (UNICEF et al, 2019). A household can be said to be food secure only if it is secure regarding of both the acquisition, and the utilization of food (FAO, 2003). According to FAO (2019), about 820 million people are chronically hungry as a result of extreme poverty and over 2 billion people are food insecure intermittently due to varying degrees of poverty globally. Household food insecurity is directly influenced by low access to food consequently, households that do not have sufficient access to food have low dietary diversity, reflecting poor nutrient adequacy (Adeyinka and Coker, 2018).

In Africa, 83 million under five children are suffering from malnutrition which is mostly effects on their health conditions (Development Initiatives, 2017). Being in Sub-Saharan African region, 3.5 million children under five years in Ethiopia are acutely malnourished. According to FSIN studied about (2019)7% of children aged 6–23 months received early ‘Least Adequate Diet’ for

growing and progress; 35% of households lacking access to safe drinking water and 39% of children aged 0–59 months stunted. Additionally, in Ethiopia with high level of malnutrition and poverty, almost one-fourth of the Ethiopian populations are malnourished with the greater ratio of suffering from severe malnutrition (Jemal and Kim, 2014).

A document prepared by Oromia Bureau of Agriculture (2014) presented that out of the 18 administrative zones and 265 districts of Oromia National Regional State, 9 zones and 79 districts were frequently food insecure. According to this document, East Shewa is one of the zones that included districts identified as chronically food insecure, namely: *Gelan* Town. CSA (2016) clearly shows there is a problem in nutritional status of children in the region indicating the contribution of food insecurity in the area to the nutritional status of children. Particularly a document from *Gelan* Town Finance and Economic Development Office (2012) has revealed some constraints predominant in the town that could have a strong implication on food security of the people in general. The constraints identified increased unemployment rate, low agricultural productivity, desertification, lack of capacity of office workers, widespread dependency syndrome, and the gradual expansions of desertification were included. This, in turn, results in poor nutritional status of children in the district. This thesis helped to bring an understanding of the nexus between household food security and nutritional status of under five children in Gelan Town, Oromia region.

1.2. Statement of the Problem

Food insecurity is a global problem. The world is struggling to address it since decades back but still far away from a decisive victory. In the year 2018, around 2 billion suffering from food insecurity (globally) lacked access of adequate food for a healthy and active life (FAO et al., 2019). Low-income, geographical pattern, and climate change and variability such as drought and flood cause poverty and malnutrition (FAO, 2010). Over the last two decades, starvation, malnutrition, and chronic food insecurity has continual to be discussed as a worldwide problem that is not due to a food-deficit at the international and nationwide levels, but to a lack of access and redistribution at the household level (Clark, 2009). More well-known common form of food insecurity occurs when food is inaccessible for a feed due to inadequate resources and, consequently, results in the physical and psychological outcomes of child malnutrition and hunger (Abbasi et al., 2016). The most recent press release by the World Health Organization

(WHO) reported that the right speculation in nutrition intervention programmed could save the lives of 3.7 million people by 2025 (WHO, 2019). But still far away from a significant effect, still a global public health problem.

Africa is not on track to meet Sustainable Development Goal (SDG). Likewise, progress towards meeting the WHO global nutrition is too slow at a continental level to meet any of the targets **(**UNICEF et al., 2019). Nowadays, there are around one billion malnourished people in the world, more than 36.4 million in 2015. Of these 257 million are in Africa, of whom 237 million in sub-Saharan Africa. At the regional level, the incidence of stunting ins children under five is falling, but only a few nations are on track to encounter the worldwide nutrition board for stunting. Nevertheless, the prevalence of child malnutrition continues to increase and now affects 20 percent of the population, more than in any other continent. The prevalence is 8.5 percent. In the region of Horn of Africa, the upward trend appears to be increasing, and now twenty- three percent of the all the population is undernourished (WHO et al., 2019).

According to the Ethiopia Humanitarian Disaster and Resilience Plan 2018, In 2018 *belg*[1] harvest assessment, 3.5 million children under five and around one million pregnant mother and lactating women were intensely undernourished in September up from around four million in January. The number of intensely malnourished children reached more than three thousand in the early 2018 to 2.4 million by September. Particular 370 000 of them (up from 350 000 in January) were predictable to be harshly undernourished, with Oromia (139 000), Somali (99 000), south nation and nationality people (SNNP) (54 000) and Amhara (42 000) the worst-affected regions. Around 7.9 million were in need of food-related humanitarian assistance – including 3.2 million in Oromia, 1.8 million in Somali region, and 977000 people in Amhara, according to the Humanitarian and Disaster Resilience Plan (HDRP) for 2018 (FSIN, 2019). According to the 2014 Africa food security, and hunger undernourishment multiple indicators score card Ethiopia is ranked first, as the population of the country who are food insecurity roughly 32 million of the total population is in state undernourishment (ADLI, 2014). Another global food security index shows that Ethiopia is still facing the problem of food insecurity with 32% of the population being undernourished (The Economist Group, 2017).

[1] Small rainy season mostly from February to April

Moreover, previous studies have noticed that despite the precedence given to tackle food insecurity by the government of Ethiopia, the problem still continues (Vadala, 2009; Gill, 2010; Guyu, 2015; Belay & Dawit, 2017). This holds true to the situation in Gelan District, Oromia National Regional state, which suffers from repeatedly occurring food insecurity (Belachew, 2018). As a result, Gelan Town is known as one of the chronically food insecure districts. This could be partly due to the soil related sensitivity, high vulnerability levels and climate aridity problems in the district. In addition, an increased rate of resource degradation, salinity, and clearance of vegetation cover coupled with bad agricultural practices and misuse/overuse of resources were the other problem areas identified (Gelan District Finance and Economic Development Office, 2012). Similarly, a study conducted by Habtamu (2011) also affirmed that the fast rate of urbanization displaced farmers and affects their livelihood as well as their confidence to invest to improve their living**.** Under- five Children are most at risk, for they are more susceptible to contrary surroundings, and respond fast to dietary changes. On the other hand, illegal settlement and bare/degraded lands have constraining agricultural productivity in general and the food security situation of the district in particular.

Furthermore, intensive research work have been conducted to assess the status of food in/security in Ethiopia (e.g. Abebaw and Ayalneh, 2007; Maes et al., 2009; Messay, 2009; Alemseged, 2016; Garedew, 2017; Abayineh and Belay, 2017; Malla et al., 2017). However, most of this research did not address the nutrition status under five children. Besides, most of these studies used single measurements such as kilo calorie and thus, inadequate to determine food in/security at intra-household level. The use of single indicator is said to give a fractional view of the dimensions of food (in) security that would result in less effectiveness of further interventions and limited to show (indicate) the intra-household nutrition status of under five children (Coates, 2013; FAO, 2013).

Therefore, this study would be conducted to fill this gap by sharing strong empirical evidence on the nexus between household food security and nutritional status of under five children in the in Gelan Town, study has tried to look at the linkage between household food security, and nutritional status of under five children in Gelan Town, despite common existence of both forms of public health problems of food insecurity, and under nutrition in the same community of Gelan Town, and the study to show that an increasing awareness on the seriousness of

association between household food security and nutrition status of under-five children in the study area. The focus of this study is to address the nexus between household food security and nutritional status of under five children.

1.3. Objectives of the Study

The main objective of the study is to investigate the nexus between household food security and nutritional status of under five children in Gelan town, Oromia region.

1.3.1 .Specific Objectives

More specifically, the study aspires to:

1. Describe the status of household food security in the study area.
2. Analyze the prevalence of malnutrition (stunting, wasting, and underweight) in the study area.
3. Evaluate dietary intake of children under five years of age in the study area.
4. Examine the association between household food security and nutritional status of children under five in the study area.

1.4. Research Questions

1. What is the level of food security situation at household level and to what extent do the household access enough food?
2. What is prevalence of malnutrition in study areas?
3. Does a child feeding practice influence the nutritional status of under five children?
4. Is there an association between nutrition status of under five children and household food security?

1.5. Scope and Limitation of the Study

The study has limited spatial scope *i.e. Gelan* Town. It has also limitation in that it focuses to investigate the nexus between household food security and nutritional status of children under five. The limitation of the study was unavailability on my appropriate title to get previous research in the study area or like areas, making it is difficult to associate the details of the finding of this research with similar studies. This thesis has limitation with regard to data achievement

(in amount and time horizon) as a result of limited available financial and time resources. Nutritional assessments were done using anthropometric measurements which subsequently were compared to WHO criterion (SD classification) using summary guides of nutritional status: weight-for-age, height-for-age and weight-for-height. Due to time and resource constraints the study did not much consider the dietary diversity of the households. Specifically, the width and breadth of this research is limited, severely at times, due to the time and monetary costs involved in securing ethical clearance, enumerator recruitment training, contemporary issue of pandemic disease (covid-19) is highly influenced data collection processed. It is hoped that results reported in this thesis is used as a stepping stone for additional studies with larger sample size and greater representation of the different strips of Gelan town for a more reliable guide to policy and interventions.

1.6. Ethical consideration

In a case of data collection, ethical considerations was seriously taken into account to ensure the protection, integrity, anonymity, consents, and other human elements of the informants and follow ministry of health Ethiopia and WHO instruction to followed instruction of pandemic disease (covid-19) obligation. The respondents were identified by names and their consent was required during interviews and discussions. The objectives of the research were clearly explained to focus group discussions, key informants and other concerned parties who have been involved in the research data collector and participant to take distance measure 2Feet each and every moment. At the time of data collection, consent was required from participants to confirm their willingness to participate in the study area. Accordingly, participation was voluntarily and measure has been taken in keeping the respect, dignity and freedom of each predication.

1.7. Significance of the Study

Various researches have been conducted with regard to food security at national, regional, and global levels. However, there is no or only small number of researches on nexus between household food security and nutrition statues of under five children with empirical evidence in Ethiopia. The output of this research, therefore, was filling the knowledge gap in local and institutional responses to household food security and nutrition statues of under five children. Finding of the thesis can helped to show synergy between nutrition statues of under- five

children and household food security based on evidences obtained from the study area. Policy - makers, local administrators, and the farmers would be benefiting from the output of the study as it would provide them with empirical and scientific evidences. Hence, finding of the thesis can contribute to the existing academic knowledge by exploring nutrition statues of under five children practices to contribute to household food security at a local level. The study would also benefit other researchers and Organizations who may intend to conduct further study on related issues.

1.8. Outline of the Thesis

This paper is organized into five chapters. The first chapter comprises the introduction of the research consisting of the background of the study, statement of the problem, research questions, and research objectives of the paper, significance, meaning of terms, debts, and limits of the thesis. The second chapter deals with literature reviewed from various sources. The third chapter provides about the research methodology with background information about the Gelan Town and the study *Kebeles,* the type of research design used the sampling techniques, the data collection methods, and also data analysis. Chapter four consists of the main studying findings and discussions, and the thesis winds up by presenting summary, conclusion and recommendations in chapter five.

Chapter Two: Related Literature Reviews

This section tries to deals with the literature part of the study. It presents an overview of the theoretical literature, food security measurement tools and overview of anthropometric indicators measurements, related empirical studies, and the conceptual framework of the study.

2.1. Theoretical Reviews

The theoretical framework of household food security has also more and more industrialized, and prolonged with happening of hunger, famine, and undernourishment are increasing from time to time in developing countries. The idea of food security reached broader awareness since the 1980s after the considered on 'accesses to food, and the focus of the unit shifted from global and state levels to household and individual levels. This elevated social and economic issue around access to food by the poor, and malnutrition was no longer observed just as a medicinal problem to be treated. Poverty and the condition nexus with it were known as the dominant causes of malnutrition (EDPPC, 2002). Food security theories that are relevant to this thesis are presented as follows;

The Food Availability Decline (FAD) Approach

This approach is surely the oldest one and still the for the most part influential. In the early 1970s, this was the reference approach for international community, both at the political and theoretical level to study food security (UNDP, 2012). Usually scarcity has been related to those factors which affect the production as the act of God and some other times, nature's fault. This approach considered scarcity as shortages of food supplies per capita, motivated by natural factors; e.g., drought, floods and other disasters that desertification; or demographic factors, i.e., vegetative growth that goes beyond supply (Sen, 1981).

This approach is known as the Food Availability Decline (FAD) (Sen, 1981 cited in Vadala, 2009). It has two types. The first one takes natural disasters like low agricultural productivity and flood as the major determinants to reduce household food production while the second version focuses on people growth (Vadala, 2009). According to this later approach, food insecurity is the consequence of imbalance between household food and intra-household member i.e. To

maintain this balance the proportion of growth of food availability should not be lower than the speed of population (UNDP, 2012)

The Food Entitlement Decline (FED) Approach

Amartya Sen's important book 'poverty and Famine' (1981) conclusively shifted the focus of scarcity analysis from supply side to the demand side. The entitlement approach underlines access to food, or people's relationship to the food, rather than the availability of food (Devereux and Maxwell, 2003).The empirical review for this study is prepared some reasons of food insecurity documented in Ethiopia and other developing countries of the world particularly in Africa And generalizes the findings of certain previous studies concerning the determinants of a food insecurity. FED has a potential capacity to identify which group of people are affected by numerous intimidation of obtain ability or access to food, differentiation depending on the degree of vulnerability (Degefa, 2005). Despite its forte, FED model has also some disadvantages to be addressed before directly applying it as a framework to study household food security. FED theory failed to consider intra household distribution of food, exclusion of relief entitlement (food aid), deeply focused on food lack and belief that scarcity mortality is persuaded by hunger, chilled mortality, and abandonment cultural preferences and tastes in food consumption, and the like.

Basic need Approach

Basic need approach is concerned with basic needs, and it highlights the poor, instant needs and specific quantities of consumption. It was meant as if income earning opportunities to the poor through rearrangement and goods and services they need (UNDP, 2012). In particular, it emphases on material needs of such as food, clothing, and shelter without which person can exist and the less tangible ones such as autonomy (Crosswell, 2012). Thus, it is against the income based approach where income alone was viewed as a means of food security.

Basic need approach was accepted based on the basic occupied paper entitled; Employ Growth, and Basic Needs prepared for the 1976 ILO meeting where it was acknowledged as priority objective to live implement in the growth plans of nation. Food for private family intake; which is termed as the most basic need was also included in the list of requirements identified to be met to satisfy basic needs of people (UNDP, 2012).

Also, while the majority of the households in the Gelan town selected kebeles have a safe source of drinking water, such as a Cartesian well and tap or public, these sources do not guarantee safe and clean drinking water because of poor water storage facilities. Most poor households use exposed plastic containers and glass bottles for storing drinking water. While there is a water pipe system, several households protested that water coming from the pipe was not drinkable due to high presence of colloidal particles. Hence, households are compelled to buy gallons of water for drinking, which is an additional burden on the insufficient household budget.

Human Capital Theory

Human capital is a comprehensive concept which identifies human characteristics, which can be acquired and which increase income. It is common to include people's knowledge and skill acquired partly through education, but can also include their strength and vitality, which are dependent on their health and nutrition (Burchi, 2006, African Development Bank, 2010).

Malnutrition in children is clearly shows to lead to eternal effects and to result in diminished health capital as adults. Further, it may also be an inter-generational cycle of malnutrition as a worse health capital stock may be passed on from adults to their children. There is sufficient indication at the macroeconomic as well as the microeconomics level. That is, health is definitely associated with other dimensions of economic prosperity, and that causality goes both directions: a person with higher income invests more in their human capital and become healthy while healthier workers tend to be more productive and receive higher earnings (James, 2009).

The Political Economy Explanation

In the continuous process, as stated by (Sen, 1981) famine theorizing has contested many aspects of the entitlement approach which finally led to the emergence of new theoretical paradigms (political economy) on the explanations and prevention of famine. Unsuitable lawmaking policies and institutional weakness are major accountable factor for the recurrence of food shortage or poverty and underdevelopment in common. Whenever food scarcity or food shortage happens in a known country; the administration is accountable for either causing the crisis or failing to prevent it. In Ethiopian, circumstances lack of appropriate development polices and strategies is one of the main issues which results vulnerability to disaster (Degefa, 2002)

Ethiopia economy faces three structural challenges that must be dealt with to achieve sustained growth: poverty reduction, proper environmental management, and adequate infra- structure. Starting with the last challenge, Ethiopia has lagged behind many of its neighboring countries in physical infrastructure to support the industrialization and the overall development effort. Inadequate port facilities, Poor roads, and unreliable and expensive power supply has increased costs and reduced economic efficiency. Many of these shortages in infrastructure have been addressed in the past few years, but much remains to be done. As far as the first challenge is apprehensive; poverty occurrence has decreased slowly over the past decades, but remains high, particularly in study areas. Bureaucracy and corruption in the government have brought about an underground system of economic activities, having to have nothing to do with government institutions and, instead, creating separate political economic system (Panopio, et al., 1994). Corruption reduces foreign and domestic investment, decreases the efficiency of investments, and leads to diverting resources to rent-seeking activities. All of these have a significant negative impact on economic growth (ADB, 2000). The administration pursues to make sure the welfare and near the beginning integration of disadvantaged group into the political and economic mainstream.

2.2. The concept of food security and nutrition status

Food security is a situation that exists when "all people, at all times, have physical, social, and economic access to sufficient, safe And nutritious food that meets their dietary needs, and food preferences for an active and healthy life" (FAO et al., 2012). The WHO state that present is three pillars to determine food security, food availability, food access, and food utilization. The FAO adds the fourth pillar mentioned the stability of the first three dimensions of food security completed stage. In 2009, the World Summit on Food Security specified that the "four pillars of food security are availability, access, utilization, and stability.

Food Availability: according to FAO (2013), food availability is one of the pillars of food security that plays a prominent role. Sufficient quantities of food of appropriate quality, supplied complete domestic production or imports (including food aid). Food availability tells to the supply of food finished production, distribution, and exchange is determined by a variety of influences including land and use; soil management; crop selection, breeding, and organization; livestock breeding management; and harvesting.

Crop production can be impacted by ups and downs in rainfall and temperatures. Food distribution involves the storing, dispensation, transportation, packing, and marketplace of food. Food-chain system substructure and storing know-hows on farms can also affect the amount of high amount food lost in the distribution process. Food availability can be seen as a physical availability of food, and it is a direct result of individual access to resources. Food availability combined with food access leads to food security at the individual household level.

Food Accessibility: food access refers to access by the individuals to adequate resources (entitlements) for obtaining appropriate foods for a nutritious diet and affordability and distribution of food, as well as the linking of individuals and households also puts "the physical and economic access of sufficient food "as the basic point of the food security definition. The property of a household, including income, land, and crop of labor, inheritance, and aid can manage a household's right to use to food. However, the ability of access to sufficient food may not lead to the acquisition of food over other materials and services. Demographics and education levels of members of the household as well as the gender of the household head regulate the preferences of the household, which influences the type of food that are purchased. A household's right to use to sufficient and nourishing food may not guarantee sufficient food intake of all household members, as intra-household food distribution may not adequately gather the requirements of each member of the household (Hiwot, 2014).

Utilization: food complete adequate diet, clean water, sanitation, and Health care to reach a state of nutritional well-being where all physiological needs are met proper biological use of food, needful a diet with sufficient energy and vital nutrients, potable water and passable sanitation, as well as knowledge of food storage, processing, basic nutrition and childcare and illness controlling. The concept of food security also has three-dimensional and sequential dimensions. It is potential to investigate food security at the worldwide, continental, national, sub-national, town, household, or individual level (Hoddinott, 1999).right to use to healthcare is additional issue of food use, since the health condition of individual's member of households controls how the food is make use of for example, intestinal parasites can take nutrients from the body, and decrease food utilization. Sanitation can also decrease the incidence and spread of diseases that can affect food utilization. The teaching about nutrition impact and food preparation process can influence food utilization and improve this pillar of food security (Maxwell, 1996).

Stability: food stability refers to food secure, a population, household or individual must have called of adequate food at all time's capability to obtain food over time. Food security can be fleeting, cyclical, or continuing. In fleeting food insecurity, food may be unobtainable during certain periods of time. At the food production stage, accepted and lack result in crop failure, and decrease food accessibility. Public conflicts can also reduction access to food. Unpredictability in markets resulting in food-price spikes can cause transitory food insecurity.

Household food security is the basic (micro) level where the degree of achievement in the progress of human development can be assessed (Hamelin et al. 1999). The focus shift of Household food security from the national and regional to the household level was investigated by observations of deficient food intakes by certain groups despite national supply sufficiency (Hahn, 2000). It is clear however, that Household food security cannot be met if food security at the upper levels is not achieved. On the other hand Household food security results can be used to describe the status of food security at regional and national levels. Intra-household, issues include food distribution inequalities within the same household such as fathers 'intake satisfaction before children and the mothers can receive their meal portions as well as food intake changes by mothers in favor of their children.

Food security can be measured at nationwide and individual levels. A national level, it is related to bodily being of food stocks for consumption from individual production or from marketplaces. Household food security is connected to the skill to obtain enough amount of food with adequate quality to meet nutritional requirements of all household members. Household level food securities mostly depend on household revenue and purchasing power of household members which over related to income delivery in the household (Motbainor et al., 2016).

Food security and nutrition status are separate yet inseparably linked components, some have continued to apply the two concepts interchangeably. Food security is necessary but not sufficient for nutrition status. Also, poor nutritional status should not be unspoken solely as revealing of insufficient food consumption (UNICEF, 1990 and Engle et al., 1999).

Nutrition status has been inspected a individual level with much attention to that of children aged 0-5 years. This is so because this group of the population is more vulnerable to inadequate food and poor nutrition. Poor nutrition in infancy and early childhood will result in poor physical

and mental development and may affect their productivity in adulthood (Martorell et al, 1993) and cause them to suffer from chronic illness and disability (Brinkman, 2010).

2.3. Food security measurement tools and Overview of Anthropometric Indicators

2.3.1. Household Food Insecurity Access Scale (HFIAS)

Questionnaire-based measures, such as the hunger scale questionnaire, have been used to obtain information on experiences and behaviors that would indicate the presence and severity of food insufficiency in households (Bickel et al. 2000).

Questionnaire-based for HFIAS consists of nine occurrence questions that represent a generally cumulative level of severity of food insecurity (access), and nine ―frequency-of incidence questions that are asked as a followed to each occurrence question to measure how often the condition occurred. The frequency-of-occurrence question is skipped if the respondent reports that the disorder defined in the consistent occurrence question was not practiced in the previous four weeks (30 days). Some of the nine occurrence questions ask about the respondents insights of food vulnerability or stress. The questions address the situation of all household members and do not discriminate adults from children or adolescents. All of the format questions request whether the respondent or other household members either touched a certain way or did a particular conduct over the preceding four weeks.

2.3.2. CHILD FEEDING PRACTICES AND DIETARY DIVERSITY

Adequate nutrition in childhood is a basic importance for decisive growth, and cognitive progress of children as well as for prevention of diseases in life span. Poor infant feeding practices attached with high rates of invective diseases are the main reasons of malnutrition for the period of the first two ages of child. Apt breast feeding, and complementary feeding follows and access to adequate amounts of appropriate foods are vital for optimal infant nutrition.

Dietary diversity is a quantitative number of food items or groups used as a method of determining variety, and nutrient adequacy of diets for an individual of infants and children. Appropriate diverse diet feeding during the first two years of life is key to improve child survival, healthy growth and development (WHO, 2017) Even with optimum breastfeeding,

children will become stunted if they do not receive sufficient dietary diversity and meal frequency after 6 months of age (Melkam Aemro, et al., 2013). Appropriate child feeding practice is vital in the first two years of life because malnutrition is common, especially in this age group. The quality of a child's food is dependent on mealtime and food groups contained in the food. On the other hand in most growing countries, infants and young children are in a straight line introduced to usual household diets made of cereal, or starchy foods (UNICEF, 2013).

2.3.3. Overview of Anthropometric Indicators

It is important to measure and monitor food security over time because it is fundamentally linked to well-being. Measurement is essential at the onset of any growth scheme to classify the food insecure, assess the severity of their food shortfall and characterize the nature of their insecurity (seasonal versus chronic). Furthermore, it provides the basis for monitoring progress and assessing the impact of these projects on the beneficiaries' food security (Hoddinot 1999).

Anthropometry measures the physical growing status of an individual household relative to international reference population. Consequence, anthropometric figures are characteristically report as index based on standard deviations from the mean of this reference population, or z-scores. In under-five children, two of the for the most part usually used anthropometric indices are height-for-age (HAZ) and weight-for-height (WHZ) (WHO, 2008).

Food security at household level can also be measured by households' food or calorie acquisition/consumption per adult per day. The calorie consumed by the household is compared with the minimum recommended calorie of 2100 kcal per adult per day. If the consumption/acquisition is less than the recommended amount then, the household is categorized as food insecure and if greater than the recommended amount then the household is considered as food secure.

Anthropometric data contain measures of weight and height, in particular for children. These measures have partial value as indicators of malnutrition by their own because weight and height depend on both age and gender. Genetic variation, among others, also affects physical characteristics. However, even in the presence of such natural difference, it is possible to use physical measurements to measure the competence of diet and growth, in specific in infants and

children. This is a total by contrast pointer with the distribution of the similar indicator for a healthy reference group, and recognize tremendous or abnormal different approach from this allocation. For instance, the three of the majority usually use anthropometric indicator for under-five children - weight-for-height, height for-age, and weight-for-age - can be constructed by compare indicator based on age, height, and weight, gender with circumstances data for healthy children (WHO, 1995).

2.4. Child malnutrition

The word malnutrition usually refers both to under nutrition and over nutrition. A lot of issues can reason child malnutrition, furthermost of which tell to poor diet or plain, and repeated infections, mostly in disadvantaged populations like under-five children. Insufficient diet and disease, in turn, are carefully linked to the general standard of living, the ecological conditions, and whether a population is bright to meet its basic needs of such as food, housing and health care (WHO, 2007).

Even though it has extended recognized that malnutrition is linked with mortality among children (Trowell, 1948; Gomez et al., 1956), a formal assessment of the crash of malnutrition as a risk factor was only recently carried out. In the early 1970's, results of the first epidemiological study on malnutrition showed that malnutrition is the major problem infectious diseases on child mortality at population level (Pelletier, Frongillo & Habicht, 1993), consequence of up until then had only been experiential clinically.

Malnutrition is one of the world's major infection disease nonetheless least-addressed growth challenges. Its human and economic costs are huge, dwindling the firmest on the poor, women, and under-five children. In 2017, 151 million children were stunted (low height-for-age), which indicates not only a failure to achieve one's own genetic potential for height but is also a predictor of many other developmental constraints, including cognitive deficits and future economic opportunities, including impeding a country's ability to accumulate human capital (World Bank, 2019).

Nutritional status is foremost determined by a child's development in height and weight and is in a directly procession influenced by food intake and the occurrence of infections. Stunt (chronic

malnutrition), wasting (acute malnutrition), and underweight (a general measure of health and nutritional status is the major manifestations of malnutrition (EDHS, 2011).

2.5. Relationship between household food security and child nutritional status

Haddad et al., (1994:329) refers nutrition security as the "appropriate quantity and combination of inputs such as food, nutrition, and health services, and caregiver's time needed to ensure an active and healthy life at all times for all people." It implies that nutrition security is an outcome of different processes that take place within the household. It also denotes quality and equitable distribution of food within household. While there are common elements in the concepts of food security and child nutrition security like availability and access of adequate food, various definitions that include the criterion of enough food for a normal and healthy life of all individuals, also create confusion (Smith et al., 1992; Maxwell and Smith, 1992; Mula, 1999; Maxwell, 1996).

The processes and time frames for reaching calorie-adequacy of household diets are quite different from those for reaching nutrition security. Households only consider quality of diets after fulfilling the energy requirements (hunger). Furthermore, non-food factors (socio cultural, knowledge etc.)

Most studies report an indirect association of household size with either child food intake or nutritional status (Onchere et al , 1981; Mrisho et al, 1990; Briones et al, 1999 **;**Safilios-Rothschild, C.S, 1990). One of the reasons given for the negative relationship is that a smaller family size allows mothers time for interacting, stimulating, teaching and disciplining their children (Frankenberger, 1992). It designated that the per-capital food available reduces with larger household size (Onchere et al, 1981).

Food and nutrition security at household level are preconditions for a good nutritional status (defined by anthropometric indicators) among the vulnerable population groups, e.g. under -fives and mothers. However, morbidity (health status) and lack of care are equally important determinants of malnutrition (underweight, wasting and stunting according to WHO cut-offs), particularly among under-fives children. Hereafter, nutritional status is a compound outcome of instantaneous and fundamental determinants (Maxwell and Smith, 1992; Haddad et al., 1994).

2.6. Empirical reviews on food security and malnutrition in Ethiopia

Achieving complete household food security continuous to be a challenge not only for developing countries, but also for developed countries. The difference lies in the extent of the household food security problem concerning its severity and proportion of the population affected. Malnutrition Investigations and analysis concerning the situation of household food security and child malnutrition its determinants have been limited in Ethiopia. This in turn caused limited understanding of the situation of food security and malnutrition determining food security a household level. However, in recent times attempts to have been made to analyze food security situation and malnutrition investigate the determinants of food security in the country, as well a household level.

(Haile et al., 2005), in their study in *Koredegaga kebele* administration of Oromiya Regional State, indicate that farmland size, oxen ownership, fertilizer application, education level of the household heads, household size and per capita production are significant determinants of household food security. (Amsalu et al., (2012), in Shashemene district of Oromiya Regional State, has examined the status and determinants of rural households' food security. Their findings show that about 36% households in the district were food insecure while 64% were food secure and the factors such as family size, cultivated land size, total farm revenue, off-farm revenue, and livestock proprietorship of households had association, and significantly influenced the household's food security status.

Degefa (1996) found out that in *Arsi,* which is considered as a one of the surpluses producing parts of the country, about 40% of the farmers in his study sample faces food shortage. He also designated that numerous physical and socioeconomic restraints were to the factors of food security in the area. These constraints are insufficient farmland for 99% of households, lack of cash income to purchase farm inputs for 79% of the households, poor quality of their farmland for 67% of the households, reliance on single harvest for 55% of the households and shortage of draft power for 33.7% of the households. He works additional found out that the before harvesting at that time of severe food shortage (Clay et al. 1998) have conducted research on household food security and food aid distribution in Ethiopia by taking a very large sample size of about 15000 households from all over Ethiopia. The study found out that even in a relatively good harvest year, 43.2% of Ethiopia's farm households face

food shortage, or have available food for consumption less than the minimum daily nutritional requirement.

In 2011, Ethiopia's under-five mortality rate was 88 per 1000 live births, a decline of over 50% since 1990 when the rate was 210 per 1000 live births According to the 2011 Ethiopia Demographic and Health Survey, 9.7% of children under the age of five in Ethiopia suffer from acute malnutrition (wasting), 28.7% are underweight, and 44.4% are chronically malnourished (stunted).

In Ethiopia, Prevalence of Protein Energy Malnutrition (PEM) in Ethiopia Under-five children: Stunted: 51% ,Underweight: 47% , Wasted: 11% overall prevalence of stunting, underweight and wasting were 45.7%,43.1% and 7.1% ,respectively (Kebede et al. 2013). According to other survey, there was, 47% of children under five are stunted and 24% are severely stunted, 11% of children under five are wasted and 2% are severely wasted. The weight for age indicator shows that 38% of children under five is underweight and 11% are severely underweight (Asrat, 2009).

Recent reports from FAO, IFAD, and WFP (2015) indicate improvements in the food security situation in Ethiopia with the achievement of MDG hunger target. Similarly, USDA (2015) confirms such improvements since 2000 with the share of food-insecure people reduced to 30 percent in 2015. In relation to the persistence of the problem, Devereux (2000) argues that the impact of the impressive [economic] growth that Ethiopia achieved since the 1990s is negligible on the household food security and too limited on poverty which overlays with household food security. The improvement may seem better when viewed in relation to the status of the country in the late 1990s and early 2000 but still a lot to be done. Thus, rather than the figure of food insecure a national level, researches needed to answer why the problem persists against high economic growth and what the problem seems local.

The Other empirical work on food security reviewed in this work is the one carried out by Workneh (2004) in this work, apart from the kilocalorie energy requirement, the researcher has tried to look into wider aspects underlying food (in) security as; resource endowments, institutions, technology, agro-ecology (Belg growers, Meher growers, and Belg and Meher growers), off-farm income, remittance And other things which together make the study more comprehensive. Unlike most of the studies on food security, the researcher has also used "panel

"data generated during mid of December 2000 to middle of June 2001. Case studies from both food secure and insecure households were also presented. In doing so, the researcher has tried to approach the multifaceted food security.

2.7. Conceptual framework of the study

Figure 2.1 shows the conceptual framework of this study. At the household level, nutritional status of under- five is determined by the nexus between dietary intake and health status of a child. These in turn, are influenced by three factors: household food security, maternal and childcare, and health and environmental sanitation. Resources for food security access to determinants the Household food security situation of the household and households can have access to food either from own production or purchase food items. Household income will empower for economic access to put it on the market and earn money from it. At the community level, the origin reason for malnutrition is poverty resulting from the unequal inter-household distribution of human, economic, and organizational resources (Leemhuis, 1998). In the case of maternal nutritional status, additional influences play a role, biological determination gender in the context of productive and reproductive roles. Also, micro nutrient deficiencies are partially diet and food-related and partly influenced by infections. However, if the household income is from employment of the mother or the father, the education the level of the two will influence their occupation. A home diet is considered adequate if food sources of protein, vitamins and minerals are eaten at least 4 to 6 times per week. Hence, as a proxy of adequacy of diets, the percent of households having the food item daily and 4 to 6 times weekly were formulated.

Health and environmental sanitation implies that in addition to food access, there are other factors to consider like safe drinking water, primary health care, and environmental hygiene to minimize gastrointestinal contagions that can contradict the benefits of a nutritious diet. At the individual level, nutritional status is determined by the interaction of dietary intake and health status of a child "appropriate quantity and combination of inputs such as food, balanced diet and health sector, and caretaker's time wanted to make sure an active and healthy life at all times for all people". It implies that nutrition security is an outcome of different processes that take place within the household. It also denotes quality and equitable distribution of food within household (Haddad et al., 1994). The contribution of morbidity to child malnutrition can only be assumed from the information on living conditions (housing, water supply and sanitation). Food intakes

were not measured but the child feeding patterns suggest that young children are prioritized. Growth faltering does start in early infancy. Biologically, well-nourished mothers should be able to produce sufficient milk to support adequate growth in the first 5 months (Shrimpton et al., 2001). However, growth faltering does start in early infancy. Biologically, well-nourished mothers should be able to produce sufficient milk to support adequate growth in the first 5 months. Environmental protection by proper environmental management is essential for sustaining growth and ensuring livelihood for some of the poorest segments of society.

Leslie (1989) has examined the relationship between maternal and childcare, including the nutritional status of children under five. She summaries a struggle in perspectives between the Child Survival literature, which tends to emphasize the negative impact maternal and childcare on child health due to less time spent in childcare doings and shorter duration of breast-feeding, and the maternal and childcare are development literature, which tends to emphasize the positive influence of increased women's income.

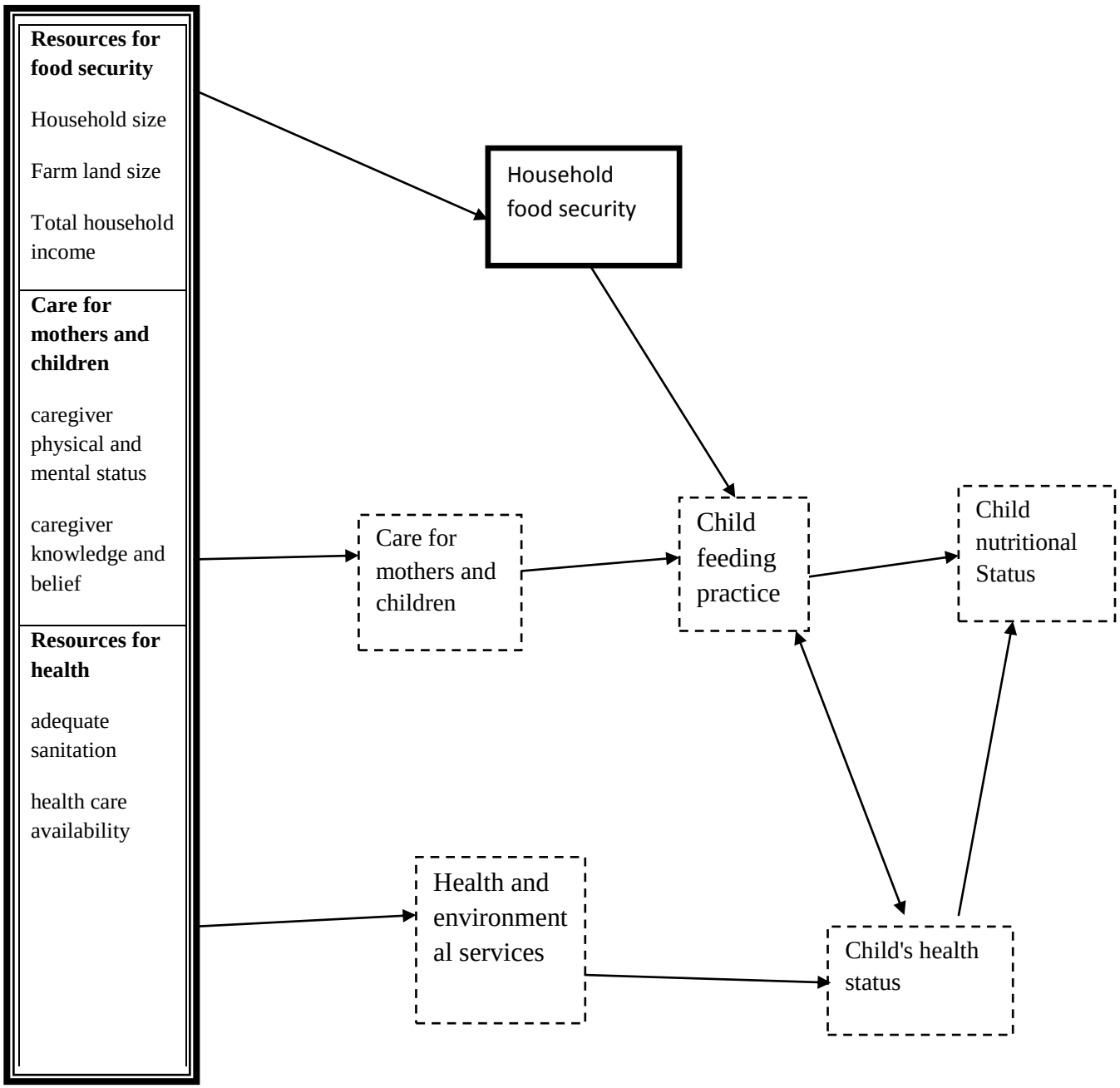

Figure 2. 1: Conceptual frame work of the study (Source: modified from UNICEF (1990 and 1998)

Chapter Three: Description of the Study Area and the Research Methods

3.1. Description of the study area

Gelan Town is located in Central Ethiopia, Oromia Regional State, at about 26 km from Addis Ababa (Figure 3.1). Gelan town is one of the eight towns of the Finfinnee Surrounding Oromia Special Zone (FSOSZ).The current boundary of Gelan and Dukem towns is made by an artificial boundary formed at the joint of the Ethio-Djibouti railway and Addis Ababa-Adama highway. The town is bordered in the East by the Dalota and Mero mountain chain, *Wedesso* Mountain chain and *Abayi Silto* peasant relations in the North, *Akaki* of Addis Ababa in the North-West and Lake Aba Samuel in North-West. Geographically, Gelan is located at $8^{0}50^{''}45^{'}$N and $38^{0}49^{''}45^{'}$E (OUPI, 2007). The entire area of Gelan Town is 7,516.8 hectares. It has an altitude among between 1,800 masl up to 2,300 masl, and a usual temperature of 19°c and an annual precipitation of 861 mm (NMS, 2013). The area experiences uni-modal rainfall patterns, mostly from mid-June to mid-September.

There were 29 peasant associations in the former Akaki district of Oromia National Regional State in 2007. Among these peasant associations, six of them were included within the planning boundary of Gelan town, either partially or fully. These include *Chefe Tuma* (fully), *Gogecha* (partially), *Insilale* (partially), *Gemeda* (partially), *Oda Nebe* (partially) and *Gelan* (fully). The Gelan Town was named following the Gelan peasant association fully included within planning boundary. It way the name of Oromo clan resides in Gelan town. The entire numbers of farmers included within the planning boundary of the town was 1303 (Habtamu, 2011).

Farming activities were the leading economic activities among inhabitants of the Town. They produced dissimilar agricultural products including *Teff,* Maize, and others for subsistence as well as marketing purposes. Farming is the means of existence for the people included within the planning boundary of Gelan town. The farmers of the area crop variety of cereal crops and feed animals. Relating to their social relations, farmers of Gelan have strong social and cultural relationships. This is shown by spatial pattern of their clearance that is mainly reflected by the settlement of male adults around their family. Farmers of the area as in most parts of Ethiopia have shared grazing areas and water ponds that serve during dry seasons. They also have a

culture of secondary each other during times of harvesting, plowing and social ceremonies during times of distress and contentment (Habtamu, 2011).

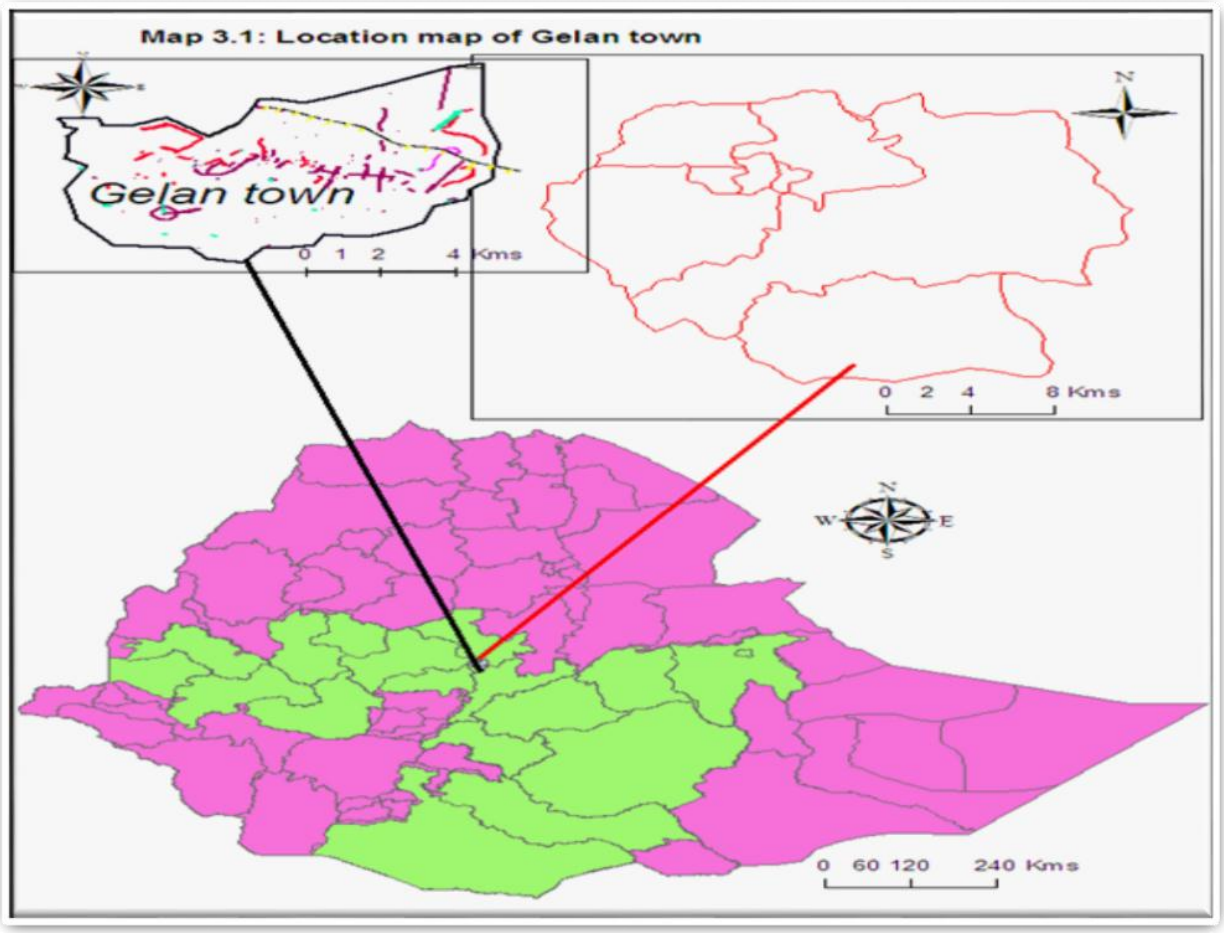

Figure 3.1: Gelan Town in its national and regional settings resources (Google map)

3.2. Research Design

The research has employed a cross-sectional survey design to explain the situation with a holistic evaluation of both quantitative and qualitative data obtained from structured questionnaires and anthropometry on the nexus between household food security, and nutritional status of children under five in the study area. A community based cross- sectional study design was used to investigate the nexus between household food security, and nutritional status of children under five in the study area. There are a lot of reasons to select community based cross -sectional study design. Cross-sectional studies measure instantaneously the contact and health outcome in a given population and in an assumed topographical part at a certain time. It is not expensive to

perform and does not require a lot of time. Cross-sectional studies can be a helpful in decisive how many children are malnourished and are affected by a condition, and whether the frequency of the incidence varies across groups or population characteristics.

Data Validity and Reliability

In order to get quality data, urban health extension workers (HEWs), who took anthropometric measurements to deal any problem arising. Also, good quality data was obtained by pretesting tools and calibrate the instrument before actually administering the tool to the target population. Special orientation was given to the data collectors to apply social distance, use sanitized equipment's, used face masks and wear glove. A daily review meeting was made with health extension workers, who took anthropometric measurements, to deal with any issues arising. Similarly, health extension workers were adequately informed to confirm quality data collection and the scales was checked continues to sanitize and calibrated every morning using the standard known weight. Each day before leaving the study area, health extension workers reviewed and signed all forms to ensure that no pieces of data were left out. The health extension workers recorded all additional important points in a notebook as soon as possible (e.g. during breaks or at the base in the evening), including observations, ideas, problems, actions taken and the rationale for such action. Each note contained the date, location, and names of relevant people. The health extension workers were adequately informed to ensure quality data collection and the scales was checked and calibrated every morning using the standard known weight. The questionnaire format was tested before the main surveys for its reliability and finally, the data was checked for its completeness before the analysis.

3.3. Sampling technique

This study applied multistage probability and non-probability sampling technique to select respondents for this study. In the first stage, Gelan Town was purposively selected to conduct the study because of high prevalence rate of food insecurity reported (Habtamu, 2011). In the second stage, study kebeles were purposely selected because the fast rate of urbanization displaced farmers and affected their livelihood. On the other hand, lack of training for farmers on the use of compensation money limited their potential to invest in different urban sectors after being organized in Micro and Small Scale Enterprises. In the third stage, households with at least one under five children in the kebeles were selected using random sampling technique. List of all the

households with at least one under five children were obtained from each kebeles. Respondent households were selected by using stratified random sampling technique. The selected households were stratified as male-headed and female-headed households. The purpose of this stratification was to explore household food security situation of different groups and to understand the most affected segment in the study area. Since kebeles differ concerning the total number of households they encompass hence, proportionate stratified sampling technique was employed to select the number of respondents from the study kebeles. Accordingly, the sample households selected from *Debre Gelan*, *Tullu Guracha*, and *Marello* is 35, 41, and 24 respectively (Table 3.1)

Table 3.1. Sample Size

Sample *Kebeles*	**Number of farm households**	**Sample households**
Debre Gelan	456	35
Tuluu Gurachaa	532	41
Mareloo	315	24
Total	1303	**100**

3.4 Sampling size determination

The sample size of this study was determined or calculated using the following formulas of sample size determination which was adopted from Singh (2007). The formula is given as,

$$n = p\,(1-p)/SE2$$

Where, n- Sample size

P-estimated proportion of respondent individual household to be food secure

SE- marginal error (sampling error)

As the proportion of respondent household to be food secure and under- five children are not known, it was assumed that 50% of respondent household were food secure and the rest food insecure. Hence, 0.5 is used as p-value to obtain the sample size (n). Similarly, the marginal error (SE) of this study was 5%, which is equal to 0.05. Therefore the sample size is determined as:

$$n = p\,(1-p)/SE2$$

$$= 0.5(1-0.5)/\ (0.05)2$$

= **100 households**

3.5. Data types and sources

3.5.1 Primary Sources

The primary data was collected from the selected sampled households. Surveys were employed using an organized questionnaire. Before starting the actual data collection, the questionnaire was pretested based on the results obtained; the essential alterations were made to the questionnaires. The household heads was asked about food security, and related issues together qualitative and quantitative data pertaining to household demographic characteristics, asset possession, off-farm/ non-farm income, livestock ownership, types, and amounts of food eaten by the household in a specific period. Other additional data were also collected including resource endowments, farm technology use, and access to credit, accessibility of farm inputs, attitudinal and other aspects of households including food and non-food consumption and expenditures. The primary data was asked where an elderly and knowledgeable person about the area was asking on various issues of the study.

3.5.2 Secondary sources

Besides the aforementioned data collection techniques and procedures, intensive desk reviewed of published and unpublished literature such as books, journals, articles, reports and e-resources would be carried out. Documents from various Oromia bureaus, Ministry of Agriculture, Central Statistics Agency document, FAO official report, policy manuals and published and unpublished work on child nutrition related materials like those from WHO (2006), and Ethiopia Demographic and Health Survey (EDHS) (2016) .

3.6 Methods of data collection

Data was collected using key informant interviews, focus group discussions, anthropometric measurements, Key informant interviews. Likewise, other relevant reports were reviewed to support the primary data and have detailed information.

Household surveys

Questionnaire-based household surveys were administered to sample farming households by using a questionnaire survey after obtaining the consent of the respondents as a research ethics.

Surveys were conducted to collect 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 sociocultural and contextual information); major sources of household income (agricultural and non-agricultural income sources). Data gatherers were well concerned with on the subject of data collection events and ethical. Pilot study was under taken for pretesting the questionnaire 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 Interviews (KII)

To have deep understanding of food security situation of the area, an in-depth interview was holed with key informants, using interview guides. The interview was conducted to investigate their living conditions in general and food security in particular and supplement the findings obtained through household surveys. For individual in-depth interview, six household was selected (two household from each gott) so that, one female headed and one male headed household from each were selected and interviewed. Similarly, interviews were held with three *kebele* administrators, three development agents, one food security and livelihood expert, one small and medium enterprise expert and the head of woreda agriculture office. The interviews were mostly tape recorded with the permission of the interviewee, in which the researcher handles the entire interview.

Field observations

A field visit was executed by researchers to substantiate and augment the information obtained through other primary and secondary data collection tools. Biophysical and socioeconomic conditions of the area were explored through the field observations. In the meantime, experts and administrators in the woreda and kebeles were briefly interviewed.

Anthropometric measurements

Anthropometric evaluation is an essential part of the nutritional assessment in geriatrics to determine conditions of malnutrition, under nutrition and overweight. Anthropometrics are a set of non-invasive, quantitative body measurements used to assess to growth, development, and health parameters. The anthropometric measurement is the furthermost communal method used sale in measuring parameters e.g. weight, height, age and mid upper arm circumference (MUAC). In anthropometric assessment the raw measurements are obtained to form guides, and then the indices are used to interpret and classify the measurements. The guides are weight -for-age (W/A), height-for age (H/A), and weight-for-height (W/H). These are compared with the recommended reference by National Center for Health Statistics (NCHS) or WHO standards.

Anthropometric measurements help to determine if a child is growing properly and can indicate when the child's health and well-being are at risk. Abnormal linear growth or weight gain can indicate a variety of medicals, psychological, or socioeconomic problems, and require additional assessment techniques beyond anthropometric measurements. Early days and teenager overweight and obesity have significant unfavorable effects on health as they can lead to type 2 diabetes, hypertension, dyslipidemia, pulmonary complications, musculoskeletal problems, and psycho social problems which may have an affects on the child or adolescent throughout life (Duncan et al., 2008).

3.7 .Techniques of data analysis

Data for this study was generated through quantitative and qualitative method. Information generated from key informant interview, and personal observation was analyzed qualitatively and the quantitative data generated from household surveys were coded and entered into computer for analysis. Statistical Package for Social Sciences (SPSS) software for Windows version 20 was used to manage the data. Then, the analyzed data was presented in a table format. Statistical analysis was carried through cross tabulation by frequency and percentage. T-test and chi-square test were used to test the determinant of stunt, underweight, and wast, and determine the association between household food security, and nutritional status of under-five children. Whether the determinants of household food security are significant or not were measured by using Multivariable logistic regression model.

Moreover, household food insecurity status of the study household was measured by the Household Food Insecurity Access Scale (HFIAS) that was advanced by the Food and Nutrition Technical Assistance (FANTA) scheme (Coates et al., 2007). HFIAS is based on the modification households make/behavioral responses with regard to their diet and consumption patterns because of a lack of resources. It is designed to capture based on households' reaction to shortage of food such as anxiety and uncertainty on supply, insufficient quality, and quantity of food. The responses are computed from the responses of households on the 9 HFIAS generic questions. The responses or perceptions of households (on supply, quality and uncertainty) against the questions (e.g. whether any adults in the household had to eat less than they thought they should, whether respondents worried about household's food run out etc.) are summarized in a scale to provide a continuous indicator of the degree of a household's food security. The food security status of households is thus categorized based on the cut-off points on the scale (Coates, 2007).

Households access to food is gathered by using the response to the nine generic questions on a recall period of 30 days as suggested by (USDA, 2000) and analyzed using frequency of occurrences (rarely – if once or twice, sometimes- if three to ten times, or often- if more than ten times). From these responses, the household food security scale is developed on continuous measures, and food secure and insecure households are identified using the cut-off point on the scale. Some studies (e.g. FAO, 2008) suggest the HFIAS 17 as cut off point in for binary classifications of households. On the other hand, studies by Garedew (2017) and (Maxwell et al., 2013) combine food secure and mildly food insecure households as "food secure" and the moderately food insecure and severely food insecure into "food insecure." But this cut off point is very sensitive, it inflates the figure of food insecure households as those who had some minor problems of food (lower score on HFIAS up to 12) can be included into food insecure category. Because of this, in the present study, drawing upon the study showed by FAO (2008) in Mozambique, HFIAS score $\geq$17 is used as a cutoff point to categorize the study households into food secure and food insecure. In addition to classifying households into food secure and food insecure once, this indicator can also be used to further specify the severity of the food security situation of the households.

The Household Food Insecurity Access was measured using a set nine questions related to Three different domains of food insecurity access: (I) anxiety and uncertainty about the household food supply; (ii) insufficient quality in terms of variety and preferences of the type of food and (iii) insufficient food intake regarding reducing quantity of food. Food security status of households as food secure, mildly food insecure and moderately food insecure will determine according to Coates (2007) using the formula:

---------- X 100

Total Number of households with HFIA category

For HFIAS measurement, each of the questions is asked with a recall period of four weeks (30 days). The respondent is first requested an incidence question-that is, whether the condition in the question happened at all in the past four weeks (yes or no). If the respondent answers "yes" to an occurrence query, a frequency-of-occurrence query is asked to control whether the complaint rarely happened (once or twice), sometimes (three to ten times) or often (more than ten times) in the past four weeks (Zeid et al., 2016).

Methods of Nutritional Assessment

Nutritional assessment is the process of estimating the nutritional status of an individual or group, at a given point in time, by using different techniques. Nutritional assessment helps to get information about the occurrence and geographic distribution of nutritional conditions within a specific community. Investigating the role of different epidemiological factors and identifying high risk groups in nutritional inefficiencies is also its advantage (Shrivastava and Ramsey, 2014). Nutritional assessment has numerous advantages: helps in detection of malnutrition, assesses the state of nutrition and subsequent interventions. It has special implication in children because nutritional problems occur frequently, and affects their health.

Nutritional assessment also involves the interpretation of methods like, dietary intake, anthropometry, biochemical, hematological variables, and clinical and physical assessment methods in a person or groups of people whether they are well nourished or malnourished (Gibney et al., 2009). By any one technique or a grouping of approaches is recommended

contingent on the purpose of the nutritional assessment. Helps in detection of malnutrition, assesses the status nutrition and subsequent interventions. It has special implication in children because nutritional problems occur frequently and affects their health.

Anthropometry: is used to assess either growth or change in the body. This method includes height/length, weight, skin-fold thickness, and head circumference etc., It detects the change of body composition to assess the nutritional status in a specific population groups, including new-born, under-five children and young (NACS, 2016).

Dietary intake assessment: In this method, there are three approaches, and the respondents are asked to record the foods and beverages, and the amounts of each consumed over one or more days (usually 3-7 days); 24-hours dietary recall, food frequency, and three-day food diary. if the individual takes at least 1-3 food groups it is said to be low IDDS tercile; if individual takes equivalent to 4-5 food groups it is said to be medium IDDS tercile, and if individual takes 6 or more food groups it is said to be high IDDS. Micronutrient intake determines the nutritional status of the individual who consume food groups that are good sources of micro nutrients, such as vitamin A and iron.

The total number of households with a HFIA category

---------- X 100

3.8. Inclusion and exclusion criteria

Inclusion criteria

All selected households with under-five years old chilled in the study area during the period of data collection were including in the study.

Exclusion criteria

Household in the study area with under-five child who had a physical deformation and/or missing limbs were not included in the study.

3.9. Description of the variables

The literature on the nexus between household food security and nutritional status of under -five children outcomes makes it clears that the choice of the dependent and independent variables vary across studies. Household food security is the dependent variable. It is measured as consequences of different conditioning association, and determinant factors, such as food supply, socio-economic activities, and intra-household of under five children. The nutritional status of children was determined by weight, age and height measurements of wasting, stunting, and underweight for children dependent variables for the reduced-form child nutrition models.

Independent Variables: based on the reviewed literature, some the common predictors that are expected on the nexus between household food security and nutritional status of under -five children status in the study area. Household income, land ownership, maternal education, mothers' occupation, maternal age, father's education, family size, farm land size, source of food for the household are some explanatory variables included in this study. In this group are characteristics of the Individual child, the household and the community.

Individual child variables: Characteristics contain age in completed a year at the time of the study for all children in the household less than five years of age. The piece wise linear condition lets the age variable to have different effects under-five child anthropometric outcomes. The age-specific measurement is underlined here, as some studies such as Sahn and Alderman (1997) have found it to be important in understanding child nutrition outcomes. Additional variables include gender entered as a dummy variable taking a value of 1 if male child to capture any gender differences.

Household level variables: characteristics are contained to shift for household history; they include maternal education and household education level. Education is based on level of formal education. A Maternal education is expected to have a direct link to child nutrition through improved child-care practices and resource distribution in the household. Other household level variables include Household income, family size, land ownership, and mothers' occupation. The household income variable was measured by income from all income activities; government employment, private, business, agriculture and so on. Household income variable is predictable to have a positive influence on both the anthropometric outcomes and dietary intakes. Household

size enters through linear indicators of the number of household member, excluding guests, in the request for dietary consumption.

The Community level variables: The variables are said to characterize the total availability of services such as health, and food prices in the communal. Source of food services is used as a proxy for the total availability of such facilities within area and the distance to the nearest such facilities if not accessible in the area. These variables go into the anthropometric result models as distance to the adjacent ability, and weighted food group prices.

Table 3.2 : Expected sign of independent variable

Variables	**nature of variables**	**Value**	**expected sign**
Age of the household head	Continuous	actual age in years	+ve/
Sex of the household head	Dummy	1 if male o if female	-ve
Marital status of household head	Dummy	1 married, 0 unmarried	+ve
Family Size of household head	Continuous	household size	+ve/
Access to clean water	Dummy	1 If access 0 otherwise	+ve/
household head of education	Continuous	years of schooling	+ve
Maternal education	Dummy	1 If access 0 otherwise	+ve
source of food for the household	Continuous	1 If access 0 otherwise	-ve
Household income	Dummy	1 if access, 0 otherwise	+ve

CHAPTER FOUR: RESULTS AND DISCUSSIONS

This chapter presents the finding of the research obtained from descriptive and econometric analysis. Household socio-demographic and economic characteristics, mother and child characteristics, household food security status and child nutritional status are presented under descriptive analysis. Descriptive analysis was conducted using t-test and chi-square. Econometric analyses were run by Multivariable logistic regression model.

4.1. Households Socio-Economic and Demographic Characteristics

The study participants' socio- economic characteristics such as area of farm land, monthly income, mothers' age, water source and family size were summarized in Table 4.1. The average household size was 4.42 while the minimum household size was two and the maximum was ten. Average monthly income of the households under study was ETB 2539.94. Only two participants own agricultural land, so it indicates almost there is no farm land in my study area, and average farm land size owned by the study group is 0.08 hectors. Water source of all participants from public tap, and it indicates the mean there is no difference water source. The households used different types of activities for safe collection and storage of water and treat it to make it safe for their consumption (100 %) of the households in selected kebeles got water from public tap/stand pipe and different types of material were used to make the collecting materials clean .

Table 4.1 : Socio economic and demography

	N	Minimum	Maximum	Mean	Std. Deviation
area of farm land	100	.00	.50	.0080	.05805
family size	100	2.00	10.00	4.4200	1.54515
monthly income	100	400.00	11000.00	2539.9400	2427.73291
mothers' age	100	20.00	40.00	26.6700	4.82430
water source	100	1.00	1.00	1.0000	.00000

Source: Field survey, 2020

4.1.2 Mothers' and children characteristics

The study results show most of the households, 87 were headed by the husband. Only in 13 households is the mother of the households (See in Table 4.2). The study findings shows that the mother's age in the study area ranges from 20 to 40 years with the average mother age of 26.67

years (See Table 4.2). Only 62(62%) mothers attended formal education of which 48(48%), 6(6%) and 8(8%) reaches elementary school (1-6th grad), secondary school (7-12th grad) and diploma and above respectively (See Table 4.2). Education of the mothers/caregivers donate to have better wages and then enhance availability of health care services which may, in turn, have a positive effect on the nutritional status of the child. With regard to marital status mothers/caregivers of the respondents, 95 (95%) were married, 1% were divorced and 3% were widowed. Breast milk only is no time-consuming adequate to meet all the nutritional conditions of infants, putting them at increased risk of malnutrition starting from six months (Dewey and Brown, 2003). Children alive in utmost developing countries are introduced directly to the regular household diet made of cereal or starchy root crops which is a major cause for the high incidence of child malnutrition, morbidity, and mortality (Krebs and Westcott 2002). Total knowledge among respondents in Gelan town selected kebeles About 8% ,39% of respondents and 53% in up to 6 month breast feed, up to one year breast feed and up to 2 year breast feed respectively. The food source of the most households 55 were from the government aid while the rest purchased 43 and 2 were from owned garden (See Table 4.2).

Table **4.2:** Socio economic and demographic characteristics of respondent (dummy variable) in Gelan town selected kebeles.

Variable	category	Frequency	percent
child's mother educational	can't read and write	38	38
level	elementary school	48	48
	secondary school	6	6
	diploma and above	8	8
Marital status	married	95	95
	divorced	1	1
	widowed	4	4
Job status of head	jobless	20	20
	private organization	49	49
	government	8	8
	laborer	22	22
	pension	1	1

Food source	purchased	43	43
	harvest farm	2	2
	Aid	55	55
Breast feed	up to 6 month breast feed	8	8
	up to one year breast feed	39	39
	up to 2 year breast feed	53	53

Source: Field survey, 2020

4.2. Food security status of the Household

Table 4.3 shows household food insecurity access scale category. Household food security status was measured by using Household Food Insecurity Access Scale (HFIAS) Based on this, findings our study showed that 8.2%, of the households in selected kebeles were food secure, 27.86% were mildly food insecure, 34.87%, moderately food insecure and 4.5% were severely food insecure because Households have experienced problems of both socio-economy access to food at variable levels of food insecurity. Distribution household food insecurity access prevalence (HFIAP) in Gelan town in selected kebeles can be seen in

Table 4**.3** : Distribution of households by HFIAS Condition

HFIAS	Occurrence		Frequency		
	No	yes	Rarely	Sometime	Often
1. In the past four weeks, did you worry that your household would not have enough food?	31	69	17	16	36
2. In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	28	72	19	21	32
3. In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	37	63	16	14	33

4. In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	24	76	23	20	33
5. In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	21	79	39	9	31
6. In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	11	89	40	16	33
7. In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?	17	83	31	19	33
8. The past four weeks, did you or any household In member go to sleep at night hungry because there was not enough food?	84	16	11	3	2
9. In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	93	7	5	1	1
Total score			201(36.28%)	119(21.4%)	234(42.23%)

Source: Owen survey data

However to being able the show the degree of food insecurity status the researcher used HFIAP score as criteria to categorize as secure, mildly insecure, moderately insecure and severely insecure household heads of Gelan Town selected *kebeles*. Of course HFIAS is better interpreted when used to assess Household Food Insecurity Access Prevalence HFIAP (Guyu, 2015).

Accordingly, the HFIAP indicator categorizes households into four levels of household food insecurity (access): food secure and mild, moderately and severely food insecure (Coates et al., 2007). Thus, household heads were categorized as increasingly food insecure as they respond affirmatively to more severe conditions and/or experience those conditions more frequently.

As shown from the result presented in Table 4.3, out of the total score of 554, it can be observed that 36.28% of households faced access problems 'rarely', 21.48% 'sometimes', and 42.23% 'often' during the last one month of the study period. Based on the categorization of Household Food Insecurity Access Scale made by FAO (2008) on a study conducted in Mozambique to determine the cutoff point, a score of 0-11 was taken as "most food secure"; 12-16 medium food insecure; and a score above 16 most food insecure.

The Household Food Insecurity Access was measured using a set of nine questions related to three different domains of food insecurity access: (i) anxiety and uncertainty about the household food supply; (ii) insufficient quality in terms of variety and preferences of the type of food and (iii) insufficient food intake in terms of reducing quantity of food. Detail Distribution of households by HFIAS Condition in the study area can be seen Table 4.4.

Table **4.4**: Distribution of households by HFIAS Condition in Gelan town in selected kebeles

Question	Frequency		
	Rarely	**Sometimes**	**Often**
1a	17	16	36
2a	19	21	32
3a	16	14	33
4a	23	20	33
5a	39	9	31
6a	40	16	33
7a	31	19	33
8a	11	3	2
9a	5	1	1

Table 4.5 shows there were only few (8.2%) of the households who were food secure (represented in light blue), i.e. such households understanding none of the food insecure conditions, or just worries, but rarely. However, the result shows there are 3 times more respondents who were severely food insecure (represented in red color), i.e. households already cut back on meal size or number of meals often, and/or understanding some of the three most severe conditions. This showed that over 92% of the study population was in a status of some degree of food insecurity. Considering the fact that the pandemic disease all over the world will spread out, and during with what was obtain in the survey, key informants and focus group discussion also indicated that food insecurity occur on recurring base.

This is just for the reason that they were engaged in farming activities. Next to that is obtain food by purchase (43%), getting through aid (55%), and through harvest farm (2%). It can be learned that one source a getting food was not sufficient to provide for the whole family members throughout the year. Again it can be seen that half of the respondents replied to have obtained food from purchase that issue of price fluctuation and marketplace in general are important factors that merit special attention when trade with food insecurity in the study area. This is for the reason that "given the heavy dependence of both the rural and urban poor on market, price rises has potentially devastating effects on the food security of poor households" (Ministry of Agriculture and Rural Development [MoARD], 2009). Similar argument was also made by van Ittersum and Giller (2014) that price fluctuations could have negative impact on the food purchasing power of consumers that are both rural- and urban-poor households.

Table **4.5**: Distribution of households by household food insecurity access prevalence (HFIAP)

Category	Total
Food secure /access	**8.2%**
Mildly food insecure /access/	**27.86%**
Moderately food insecure /access/	**34.87%**
Severely food insecure /access/	**29.05%**

Source: authors' estimate based on survey

4.3 Dietary Diversity Score of the Households

The living standard of the household determines the quantity and type of food consumed at a household level; this surges the occurrence of malnutrition. Inadequate intake of food of the right quantity and quality makes more vulnerable to malnutrition. In this study, mothers/care givers of under- five children were asked about the actual intake/consumption of food groups at house hold level in the past 24 hours before the survey.

In addition, in the field of food and nutrition have agreed that amount and type of food items consumed a household level determine nutritional statuses of household members. Based on the Dietary Diversity Score (DDS), the findings of the study reveal the majority of the household members have consumed 4-5 items of food groups among 12 food groups. The data shows among the households with 12 food groups, 55 (55%) used 4-5 items of food groups and 24(24%) also used six and more items of food groups and data shows among the households with 12 food groups also used 1-3 items of food 21(21%). Detail of Dietary Diversity households' situation in the study is shown in Table 4.6.

Table 4.6: Dietary diversity of households in in Gelan town in selected kebeles

dietary diversity score					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	21	21.0	21.0	21.0
	Medium	55	55.0	55.0	76.0
	High	24	24.0	24.0	100.0
	Total	100	100.0	100.0	

The results imply that almost half 55(55 %) of households in the study area had medium dieters diversity. Household dietary diversity is found to be one of the major factor that determine the nutritional status of all household members including children as it is seen in this study and other thesis. Children in the households with high dietary diversity score were found to have a good nutritional status (Osman and Sakka, 2013). Detail of households' food security situation in the study area is shown figure 4.1.

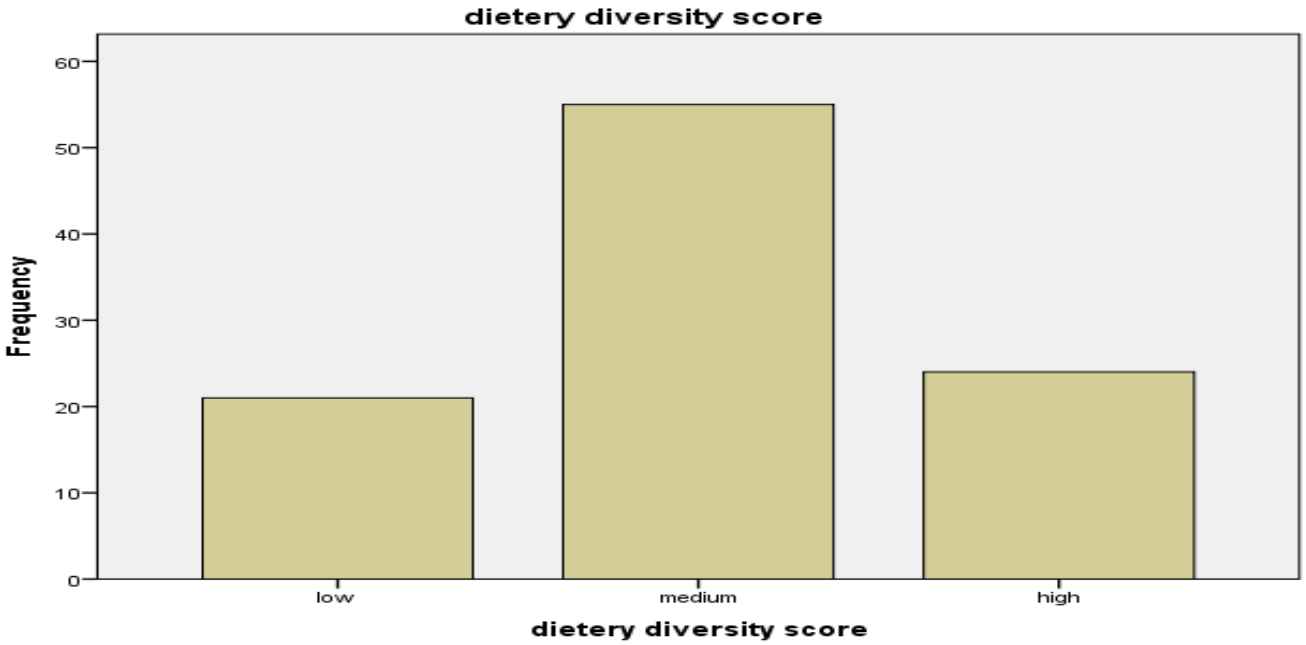

Figure 4.1: Dietary diversity of households in in Gelan town in selected kebeles

4.4. NUTRITIONAL STATUS OF CHILDREN

A community's food and nutritional status is usually measured by the nutritional status of children less than five years of age. This is the most vulnerable group to growth faltering, diseases, mental impairment and death. Child anthropometric assessment indices used are Height for Age (HFA), Weight for Age (WFA) and Weight for Height (WFH). The three indices by which a child or a group of children are compared to the reference are known as "percentage of the median", "percentiles" and"z-scores" respectively. Nonetheless, z-score is acknowledged to have a statistical meaning, and therefore, recommended. Moreover, it is advisable to report nutritional status data as z-scores rather than percentage of reference median or percentiles so as to be able to compare information from different studies (Beaton, 1993; WHO, 1994).

The findings of the study show that 7 (7%) children were found to be stunted. Prevalence of wasting seems to be low among study population .Only four children (4%) were found to be wasted. There are 13(13%) underweight children in the study population study area can be seen (Table 4.7 and Figure 4.2). A national survey conducted by the central statistical agency of Ethiopia reveals the prevalence of stunting of the country as 38.4%. Wasting and underweight the prevalence the national level was found to be 10% and 24% respectively (CSA, 2016). The

current findings are lower than the national findings. Even current findings are lower than the Oromia region. The prevalence of stunting, wasting, and underweight among children in Oromia region was 38.3%, 10.1%, and 23.3%, respectively (CSA, 2016). Rapid demographic, social, and economic changes ongoing in many developing countries have led to increase urbanization and changes in food systems resulting in a global nutrition transition where recent global shifts in dietary patterns towards higher intakes of saturated fats, sugars and refined foods, and lower intakes of fiber rich foods, driven by technological advances that have made energy dense, nutrient-poor foods cheaply available on global food markets which could have increased overweight/obesity and reduced underweight (Popkin et al, 2012).

Table 4**.7**: Nutritional status of under five children in Gelan Town in selected kebeles

	nutritional status of under five children			
	Frequency	Percent	Valid Percent	Cumulative Percent
Normal	76	76.0	76.0	76.0
Underweight	13	13.0	13.0	89.0
Stunt	7	7.0	7.0	96.0
Waste	4	4.0	4.0	100.0

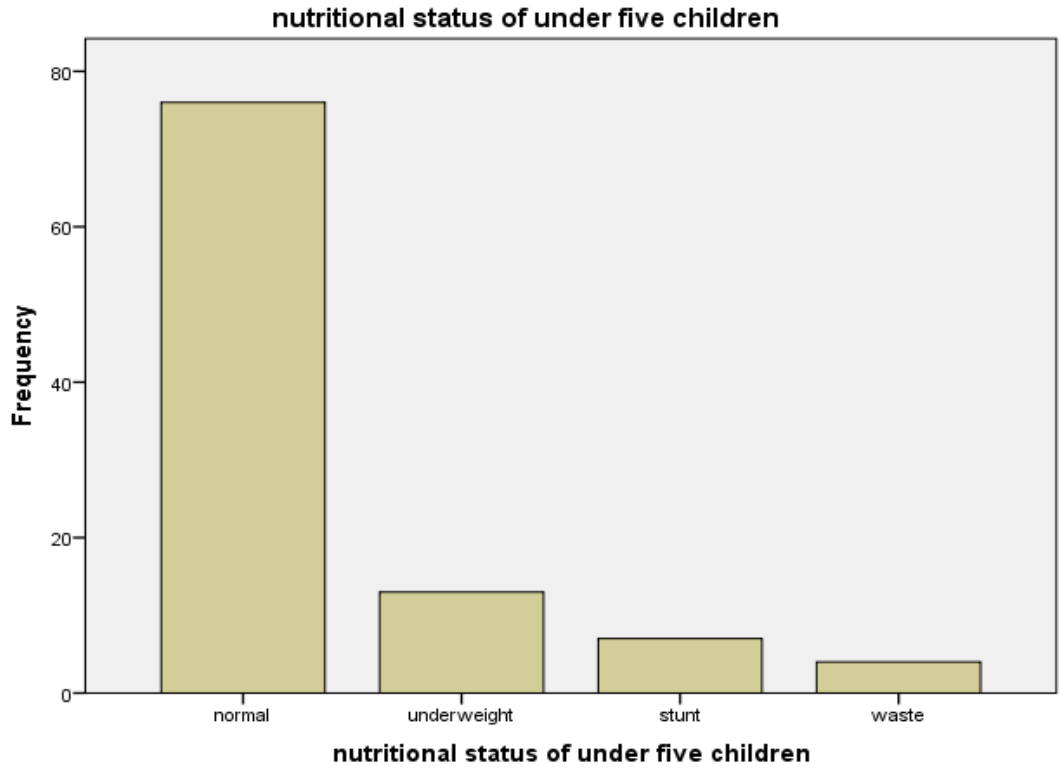

Figure 4.2: nutritional status of under- five children in Gelan Town in selected

4.4.1. T-test for stunting

The result shows no significant difference among stunted and normal children with regards to the mothers' age, family head age, family size and area of farm land. The average age of mother who were normal and stunted were 26.9 years and 23.5 years respectively. And also the family head age in normal and stunted were 33.7 years and 32.1years respectively. However monthly income shows statistical difference between households with normal and stunted child. The average monthly incomes in households with normal and stunted child were ETB 2854 and ETB 1142, respectively with 5% significant level. Monthly income of a household has a significant role in aiding households to access food either through production or purchase from market. The result implies that household monthly cash incomes matters a lot in improving food production.

Table 4.8: T - test distribution of variable for stunting among under five children in Gelan town in selected kebeles

Group Statistics						
	stunt/weight for height/	Mean	Sig Level	Std. Deviation	df	Std. Error Mean
Mothers' age	Stunt	23.5714	.654	5.31843	98	2.01018
	normal	26.9032		4.73439	6.736	.49093
Family head age	Stunt	32.1429	.248	9.19109	98	3.47391
	normal	33.7312		6.27649	6.428	.65084
Family size	Stunt	4.5714	.415	1.13389	98	.42857
	normal	4.4086		1.57588	7.861	.16341
Area of farm land	Stunt	.0000	.445	.00000	98	.00000
	normal	.0086		.06017	92.000	.00624
Monthly income	Stunt	1142.8571	.028*	782.85193	98	295.89022
	normal	2854.7742		2690.21763	20.358	278.96257

Note (*) indicates 5 % significant level
Source: authors' estimate based on survey

4.4.2. T-test for wasting

Moreover, four explanatory variables namely mothers' age, family head age, family size, and area of farm land were analyzed to show the distribution for wasting among under-five children (Table 4.9). The results show no significant difference in the mean mothers' age, family head age, family size, and area of farm land among wasted and normal children. Again only monthly income shows statistical difference at 5% significant level in children being wasting or normal. The average age of mother who were normal and wasting were 26.5 years and 30.7 years respectively. And also the family head age in normal and wasting were 33.6 years and 33.7 years respectively. The only variable observer to have a statistical significance difference was the

household monthly income.Householdes with normal and wasted child have an average monthly income ETB 2706 and ETB 3425, respectively with 5% significant level.

Table 4**.9**: T- test distribution of variable for wasting among under- five children in Gelan town in selected kebeles

Group Statistics						
	wasting/weight for height/	Sig Level	Mean	Df	Std. Deviation	Std. Error Mean
Mothers' age	Waste	.161	30.7500	98	7.80491	3.90246
	Normal		26.5000	3.089	4.64758	.47434
Family head age	Waste	.570	33.7500	98	7.50000	3.75000
	Normal		33.6146	3.189	6.47159	.66050
Family size	Waste	.474	4.7500	98	1.25831	.62915
	Normal		4.4063	3.396	1.55988	.15920
Area of farm land	Waste	.570	.0000	98	.00000	.00000
	Normal		.0083	95.000	.05923	.00605
Monthly income	Waste	.032*	3425.0000	98	5068.44815	2534.22408
	Normal		2706.1875	3.063	2533.00958	258.52421

Note (*) indicates % significant level

Source: authors' estimate based on survey

4.4.3. T-test for underweight

From the analyzed five independent variables difference in terms of underweight, household's monthly income shows statistical significance difference. The average age of mother who were normal and underweight were 26.8 years and 25.7 years respectively. And also the family head age in normal and underweight were 33.62 years and 33.6 years respectively. According to the study findings monthly income were found to be the socio demography and economy variable to have statistical significant difference between households with normal and underweight child. The average monthly incomes in households with normal and underweight child were ETB 2972 and ETB 1386.6 respectively with 5% significant level.

Table 4**.10**: T - test distribution of variable for underweight among under five children in Gelan town in selected kebeles

Group Statistics						
	underweight/weigh for age/	Mean	Sig Level	Df	Std. Deviation	Std. Error Mean
Mothers' age	underweight	25.7333	.686	98	4.71270	1.21681
	normal	26.8353		19.614	4.85221	.52630
Family head age	underweight	33.6000	.192	98	7.51950	1.94153
	normal	33.6235		17.663	6.32075	.68558
Family size	underweight	4.1333	.723	98	1.68466	.43498
	normal	4.4706		18.274	1.52431	.16533
Area of farm land	underweight	.0000	.241	98	.00000	.00000
	normal	.0094		84.000	.06291	.00682
Monthly income	underweight	1386.6667	.0049*	98	988.40902	255.20611
	normal	2972.8706		60.265	2766.35350	300.05317

Note (*) indicates 5 % significant level
Source: authors' estimate based on survey

4.4.4. Chi- square test for underweight

Chi square analysis was tabulated for dummy variables for weight-age (underweight) nutritional status of under five children in the households in Gelan town selected kebeles. Attributes such as child sex, food source, job status of head, breast feed showed no significance difference among the discreet, while the rest attribute such as household food insecurity access scale and dietary diversity showed inter-group statistical significance. The result substantiates possible difference between households with normal and underweight children. The finding reveals that 64.7% male children were normal 46.7% male children were underweight. While 78.9% and 21.1% female children were normal and underweight respectively. This result shows there is no statistical significant difference in the other word there is no significant association between child sex, and underweight, job status of head of the household's government employed and pension in the study area cannot be affected underweight child, but result shows statistical there is no significant difference job status of head.

Another interesting result was found in breast feed and food source in terms of the household means of food and under five children. Breast feed to understand that different types of food nourish the body and influence health, but in the study area there is no significant association

between breast feeding and underweight. This is probably due to mother complementary feeding should start longer sufficient to meet all the nutritional requirements of infants.

The household food security statuses were found to have strong significant difference on underweight. Results show that about 89.1% and 71.4% of under five children are found in households with medium food insecure and severely food insecure, respectively. The difference among the three groups was observed at 1% significant level. Another explanatory variable found to have a statistical significant difference were the household dietary diversity score. Three classes of households were generated based on their dietary diversity score. Households with low dietary diversity, households with medium dietary diversity and households with high dietary diversity. Under five children in households with high dietary diversity score were 95.8% normal and 4.2% underweight. Whereas, children in households with medium dietary diversity and low dietary diversity score were 90.9% and 57.1% normal respectively. Similarly, about 9.1% and 42.9% children were underweight in household with medium and low dietary diversity score, respectively. Differences in the three classes of households were observed at significant level 5%. This finding indicates that underweight children in the study area were dominant in households with low dietary diversity score.

Table 4**.11**: chi–square of variable for underweight among under five children in Gelan town selected kebeles

Variables	**Percentage distribution of underweight/weigh for age/**				
		Normal	underweight	Chi-square	p-value
Child sex	Male	64.7%	46.7%	1.761	.249
	Female	78.9%	21.1%		
Food source	Purchased	93.0%	7.0%	4.529	.104
	Harvest farm	100.0%	0.0%		
	Aid	78.2%	21.8%		
job status of head household	Jobless	70.0%	30.0%	5.740	.219
	Private organization	85.7%	14.3%		
	Government	100.0%	0.0%		
	Laborer	90.9%	9.1%		
	Pension	100.0%	0.0%		
Breast feed	Up to 6 month	100.0%	0.0%	5.740	.219
	Up to one year	76.9%	23.1%		
	Up to 2 year	88.7%	11.3%		
Household food insecurity access scale *	Food secure	100.0%	0.0%	6.285	.043**
	Medium food insecure	89.1%	10.9%		
	Severely food insecure	71.4%	28.6%		
Dietary diversity score	Low	57.1%	42.9%	16.497	.000*
	Medium	90.9%	9.1%		
	High	95.8%	4.2%		

Note (*) indicates 5 % significant level
Source: authors' estimate based on survey

4.4.5. Chi- square test for wasting

The study further carried out chi square test for dummy and scale variables to substantiate possible difference between households with normal and wasted children. The finding reveals

that 95.2% of male children were normal and 4.8% of male children were wasted. Likewise, 97.4% and 2.6% female children were normal and wasted respectively. This result shows that a statistical there is no approach significant difference approached to alpha (confidential level) five present in being normal and wasted in terms of child sex.

The result shows a 5% significantly level of statistical difference in child being normal and wasted in terms of food source, job status of head, breast feed and household food insecurity access scale. No statistical significantly difference were observed in the result between children being normal and wasted.

About 4.2% and 14.3% children in households with high, and low dietary diversity, were wasted. And households with high, medium, and low dietary diversity had 95.8%, 100.0% and 85.7% normal children, respectively. This shows that the prevalence of wasted children in households with dietary diversity is low. While wasting is dominant in households with low dietary diversity followed by households with medium dietary diversity. Similarly, 1% significantly level of statistical significant difference were observed in children being normal and wasted in terms of households' food security status.

Table 4**.12**: chi–square of variable for wasting among under- five children in Gelan town selected kebeles

Variables	**Percentage distribution of wasting/weight for height/**				
		wast	Normal	Chi-square	p-value
Child sex	Male	4.8%	95.2%	.299	.585
	Female	2.6%	97.4%		
Food source	Purchased	2.3%	97.7%	.700	.705
	Harvest farm	0.0%	100.0%		
	Aid	5.5%	94.5%		
job status of head household	Jobless	10.0%	90.0%	4.828	.305
	Private organization	2.0%	98.0%		
	Government	12.5%	87.5%		

	Laborer	0.0%	100.0%		
	Pension	0.0%	100.0%		
Breast feed	Up to 6 month	0.0%	100.0%	.470	.791
	Up to one year	5.1%	94.9%		
	Up to 2 year	3.8%	96.2%		
Household food insecurity access scale	Food secure	0.0%	100.0%	4.611	.100
	Medium food insecure	1.6%	98.4%		
	Severely food insecure	10.7%	89.3%		
Dietary diversity score	Low	14.3%	85.7%	8.079	.018*
	Medium	0.0%	100.0%		
	High	4.2%	95.8%		

Note (*) indicates 5 % significant level
Source: authors' estimate based on survey

4.4.6. Chi- square test for stunting

Dummy and scale variables were analyzed to see if there is a difference in the independent variables among households with normal and stunt children. Child sex, food source job status of head, breast feed, household food insecurity access scale and dietary diversity score all variables are there is no statistical significance difference. The Distribution of having a normal weight for height ratio among male and female children were 91.9% and 94.7% respectively while 8.1% male and female children 5.3% were stunted showing there is no statistical significant at 5% significant level . Similarly, there was no statistical difference observed on child stunt among households, diverse food source, and job status of head, breast feed, household food insecurity access scale and dietary diversity score.

Though there is no significant difference observed, children in households that obtain food from their own garden benefits more compared to children in households that obtain their food from market regarding having a normal weight for height ratio. All children in moderate and severely food in security households had normal weight for height 92.2% and 92.9%, respectively However, the result shows no statistical significant difference of stunting with household food security status. Stunting reflect breakdown to be given sufficient nutritional more than a long period of time and is also not effect by recurring and chronic illness.

Table4**.13**: chi–square of variable for stunt among under- five children in Gelan town selected kebeles

Variables		**Percentage distribution of stunt/weight for height/**			
		stunt	Normal	Chi-square	p-value
child sex	male	8.1%	91.9%	.284	.461
	female	5.3%	94.7%		
food source	purchased	4.7%	95.3%	.884	.643
	harvest farm	0.0%	100.0%		
	Aid	9.1%	90.9%		
job status of head household	jobless	5.0%	95.0%	.875	.928
	private organization	8.2%	91.8%		
	government	12.5%	87.5%		
	laborer	4.5%	95.5%		
	pension	0.0%	100.0%		
breast feed	up to 6 month	0.0%	100.0%	1.294	.524
	up to one year	5.1%	94.9%		
	up to 2 year	9.4%	90.6%		
household food insecurity access scale	food secure	0.0%	100.0%	.668	.716
	medium food insecure	7.8%	92.2%		
	severely food insecure	7.1%	92.9%		
dietary diversity score	Low	9.5%	90.5%	2.381	.304
	medium	9.1%	90.9%		
	High	7.0%	93.0%		

Note (*) indicates 5 % significant level
Source: authors' estimate based on survey

4.5. Nutritional Status and socio-demographic characteristics

Table 4.14 represents relationships and associations between socio-demographic characteristics of the study households, and nutritional status of children in the area. All significance values for this section were obtained from Pearson Chi-Square tests.

It can be seen that prevalence of malnutrition decreases with the level of education of the head educational level. However, not all nutritional indices have significant relationship with the level of education of the household head. There is no evidence (P>0.05) to suggest significant positive association between level of education of the household head and stunting. Wasting and Underweight are also seem to follow the same trend with the rise in level of education. However, still, this factor does not seem to significantly influence wasting and stunting (P>0.05). The Education level of household head was found to be slightly associated, although not to a significant level, with the nutritional status of under-five children (Table 4.14).

Increased knowledge and skills enable women to feed and thus enhance to improve children nutritional status and improve the quality of day to daycare women give themselves and all members of their household, especially children (Ongosi, 2010). Maternal nutrition information has frequently been recognized as a significant target for nutrition endorsement interventions (Laurens, et al., 2012). It can be seen that prevalence of malnutrition decreases with the breast feed of under- five children. However, there is no evidence (P>0.01) to suggest significant positive association between level of education of the breast feed and stunting. Wasting and underweight also seem to follow the same trend with the breast feed. However still, breast feed does not seem to significantly influence wasting and stunt status (P>0.01) (Table 4.14).

Regarding the relationship between nutritional status of the children and marital status of the women, findings of the study indicated that divorced women had better nutritional status of under five children than married and widowed women.

The statistical test made on the results of the overall HDDS shows there was a statistical positive significant difference across the sample kebeles about the HDDS at $p< 0.01$. The result implies that sample kebeles were more food insecure due to lack of the means to acquire and consume a variety of foods; those who have medium level of food insecure respondents have HDDS ≥ 8 that they were food secure and were able to acquire and consume a variety of foods. In fact, it should be noted that the HDDS value could be reduced if sugars and beverages are to be taken out, because they do not add to the nutritional quality of the diet (Faber et al., 2009).

Table 4**.14**: nutrition status and socio-economic characteristics

variable	Nutritional status and socio-economic characteristics			
	Description	nutritional status of under five children		
		underweight	stunt	Waste
head educational level	can't read and write	4	1	0
	elementary school	4	5	3
	secondary school	4	1	0
	diploma and above	1	0	1
	Significance	P=0.128	P=0.916	p=0.426
breast feed	up to 6 month	0	0	0
	up to one year	7	2	2
	up to 2 year	6	5	2
	Significance	P=0.137	P=0.524	P=0.791
marital status	Married	12	6	3
	Divorced	0	0	0
	Widowed	1	1	1
	Significance	P=0.763	p=0.322	P=0.073
living home owner	Own	11	5	3
	Rent	2	2	1
	Significance	P=0.093	P=0.824	P=0.759
household head sex	Male	12	6	3
	Female	1	1	1
	Significance	P=0.429	P=0.916	P=0.466
dietary diversity score	Low	8	2	3
	Medium	4	5	0
	High	1	0	1
	Significance	P=0.000	P=0.304	P=0.018

Note (*) indicates 5 % significant level
Source: authors' estimate based on survey

4.6. Determine the nexus between household food security and nutritional status of under -five children.

Household Food insecurity access score revealed that underweight children are strongly not being in household food security. In this study household food security was strongly associated with underweight children from food insecure households. Those severely food insecure and moderately food insecure households had higher odds of being underweight. Based on these findings, it showed that children's nutritional status in selected kebeles has significantly affected by underweight and magnitude of association of underweight p=0.001 and 0.331 respectively household food security and underweight (Table 4.16).

Any situation that limits real incomes of families and in the accessibility of food can be expected to result in a substantial faltered growth and hence, could end in underweight. As this study was conducted where most households procure their food supplies through purchases, it is thus understandable that households which produce a major share of the food they consume may be less subject to insecurity than households which depend almost entirely on purchased foods. Although our study did not measure poverty directly, the significant associations between wealth index and child underweight suggests that poverty may be a major determining factor of nutritional status of children in Gelan town in selected kebeles. Results were shown on effect of means of food determine in the nutritional status of under five children concerning underweight ratio. Probability of children having a normal weight for their age an increase in households which obtain their food from there on garden by 5% significant level and chance of under-five children being underweight decreased by 0.07 and 0.005, respectively. Similar research findings were reported by Talukder et al (2010), Mutambare et al (2013) and Mulim et al (2017). However, the study of Peteros et al (2018) reported no significant relation of source of food and malnutrition of under-five children.

The means of households food security is other factor well-intentioned consideration that positive effects was observed at stunt under five children at 5% significant level normal child while put negative influence on stunted and normal child a significant level and to determine association . It can be inferred that children's nutritional status in Gelan town in selected kebeles is 1% significantly difference and coefficient between 0.965 and marginal effect 2.625 of cited

with both to determine association between stunt under five children status and household food security look (4.16). As substantiated by the pilot project report of FAO, home gardening is the key to improve the nutritional status children and community in general (FAO, 2006). The result of the this study is similar with that of a study carried out in Tigray region of Ethiopia that shows there was statistically significant difference in underweight between food secure and food insecure households in which children from food insecure households had about 48% at higher chances to be stunted when compared to the children of food secure households (Kahsay et al, 2015). According to Lwang (2015), stunting was most prevalent in food insecurity households. Another study in Gambella town states the odds stunting were highly noticeable in those children who were from food insecurity. This is what was observed in the study and also severely other studies report similar findings. According to study by Mutambare and his colleagues, chronic malnutrition was lower in children after they study consuming food from homegrown products (Mutambare et al, 2013).

According to estimate results, height for age renders positive relationship between nutrition statuses of under five children being normal. While it shows negative relationship with under-five children at 1% significant level. The association between household food security and nutritional status of under five children are presented in Table 4.15

Table 4**.15**: factors affecting nutritional status of under five children in Gelan town selected kebels.

Likelihood Ratio Tests				
Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	Df	Sig.
Intercept	17.789[a]	.000	0	.
HFIAS	30.444	12.655	6	.049

a. The dependent variable has only one value observed in 1 (33.3%) subpopulations.

Table **4.16**: Determine the association between household food security and nutritional status of under five children in Gelan town selected kebels

nutritional status of under five children	Intercept	Coefficients	P value	Marginal effects
Underweight	food secure	.331	.000***	1.393
	medium food insecure	.944	.461	2.571
	severely food insecure	-.944	.461	.389
Stunt	food secure	.965	0.000***	2.625
	medium food insecure	2.015	.158	7.500
	severely food insecure	-2.015	.158	.133
Waste	food secure	-19.123	.000***	8.077
	medium food insecure	-2.023	.086	.132
	severely food insecure	3.178	.000***	24.000
Normal	food secure	1.674	.008*	0.000
	medium food insecure	2.277	.056	9.750
	severely food insecure	-2.343	.048**	.096

*Significant at the 10%, ** Significant at the 5% and *** Significant at the 1%

Source: author's estimates based on survey

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The study aims was to analyze the nexus between household food security and nutrition status of under five children Gelan town in selected kebeles. Findings of study to reveal that only 8.2% of households participated in the study was food secure, while the rest 91.8 % of households were in some forms of food insecurity. Dietary diversity is also predominantly low in the study area. Multiplicities of factors interact to influence child's nutritional status in the study area. Underweight in the area was very high significantly public health problem with 13% under five children being shorter for their height the other two under-five children nutritional status indicators were also found to be public problem. The result implies nutrition intervention target children need to address household food security.

This study showed that under five children were anthropometric assessments, based on age, weight, and height showed that underweight (13%), stunting (7%), wasting (4 %) and under nutrition (13%). The nexus between household food security and nutrition status of under five children Gelan town in selected kebeles analysis indicated that prevalence of stunting, Wasting, and underweight are positively associated with household income activities and household monthly Income. The finding implies nutrition interventions targeting children need to address household food security, this study indicates that malnutrition is still an important public health problem among children in the area, and Dietary diversity, and household food insecurity was significantly associated with nutritional status of under-five children.

5.2 RECOMMENDATION

Based on the research findings, the following recommendation is put forward to improve the household food security and nutrition status of children under-five in the study area.

- Household income of a household has significant positive contribution to the status of household food security, and nutrition status of children. Therefore, it will be important to design and implement strategies (activities) that can boost total annual income of households. Additional study is also essential to investigate appropriate off-farm and/or non-farm income generates activities to make possible recommendations. Therefore, attention should be given by government to create access to better farmland size for the food insecure households. The success of promoting income-generating activities to ensure household food security and poverty reduction is conditional on the fact that the targeted groups maintain control over a fair share of the resources generated. This applies to both household and intra-household levels. This applies to both household and intra-household levels. In addition, improvement in access to agricultural inputs, extension services, agricultural credit and land productivity improvement technologies should be given more attention by government and non-governmental organizations.

- Since the local government of the town recognizes malnutrition as one of the main public health problems, the government should consider nutrition as household food security indicator and has advocate for nutrition education at the national and at the household levels to improve the health status of children. However, nutrition education is still unavailable to the majority of Ethiopians since most people cannot read or do not have access to nutrition, information though there is a good quality create. This component needs to be strengthened through all available channel like health and nutrition education of mothers and community at all contacts through, Primary Health Care Centers, Hospitals , health post at sub-district level etc.

- The households should feed their children at least four types of food group to build up their psychological and physical growth which means minimize child underweight, stunting and wasting rate. Given the limited option to produce enough food to cover the

dietary needs of households, policy and program emphasis should be on the creation of wage-earning nonfarm employment.

- Further studies need to conducted in the area to clearly identify determinants of under - five malnutrition and food security situation in the study area with large sample size .Studies should also give focus on the relationship food security and nutritional status of under five children.

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Annex I. Participant Information Sheet and Consent

Hello. My name is Redwan Mohamed and I am a student at Addis Ababa University. I am conducting a study on The Nexus between Household Food Security and Nutrition Status of Children under five in Gelan Town, Oromia region, Ethiopia. I and health extension will ask you questions about Household Food Security, Nutrition Status of Children, and infants feeding and will also measure your infants weight, age and height.

Your participation in this study will not involve any known risks or minimal risk to you. By participating in this study and answering the question you will not receive any direct benefit. However, this will help to improve the child nutritional status by understanding Household Food Security. Whatever information you shall provide will be kept strictly confidential and will not be shown to any other persons. Participation in the study is voluntary and you can choose not to answer any individual question or all of the questions.

.....	……	……
Name of respondent	Date	respondent

.....	……	……
Name of researcher	Date	Signature of researcher

Annex II: English Questionnaire Version 1

PART. 1. General information

1. TOWNE: _____ Kebele Name:_____
2. Household Identification Number: _____
3. Name of household head: _____
4. Date of Interview: _____
5. Time of interview: Starting time: _____, Finishing time: _____

PART .2.Household Demographic Characteristics

1. Sex of household head: a) Male b) Female
2. Age:_____
3. Marital status: a) Single b) Married
   c) Divorced / widowed d) Separated e) Others, specify
4. Educational Status:
   a) Illiterate b) Read and write c) Church school d) Other, specify
5. Ethnicity: a) Oromo b) Amhara c) Other, specify
6. Religion: a) Christian b) Muslim c) Other, specify
7. Number of permanent household including household head at time of survey (Male_____
   Female _____Total _____)

PART .3 Asset ownership and Sources of Income of Households

S.No.	Questions	Response categories
1	Do you have land for farming?	1. Yes 2. No
2	If your answer is **Yes**, how do you get it?	1. Redistribution by *kebele* 2. Through gift from parents 3. Share-cropping 4. Renting 5. Purchased 6. A combination of the above, please mention _____
3	How much is your farming land?	_____ hectares
4	What has happened to your land holding over the last ten years?	1. Increased 2. Decreased 3. No change
5	If your response is **decreased**, what is the reason?	1. Shared with children 2. Redistribution of land 3. Abandoned due to decline in quality of land

		4.Other (specify) _____
6	What has happened to your level of crop production over the last 5-10 years?	1. Increased 2. Decreased 3. Not changed
7	If it has **decreased**, what do you think are the reasons?	1. Lack of access to modern inputs 2. Due to recurrence of drought 3. Due to recurrence of flooding 4. Due to land degradation 5. Inability to purchase modern inputs 6. Prevalence of pest and diseases 7. Others (specify) _____
8	How many years have you been in farming?	_____ years
9	How many livestock do you own?	1. Oxen = _____ 5. Sheep = _____ 2. Cow = _____ 6. Donkey = _____ 3. Calves = _____ 7. Camels = _____ 4. Goats = _____ 8. Poultry = _____
10	What are the main problems you faced in relation to livestock production?	1. Shortage of feed for animals 2. Animal disease 3. Shortage of open space for keeping 4. Lack of better breeds 5. Lack of veterinary services 6. Shortage of water 7. Others (specify) _____
11	Do you have access to communal resources?	1. Yes 2. No
12	If your answer is **Yes**, what are these resources?	1. Grazing land 2. Forest 3. Construction material (sand and stone) 4. Others (specify) _____
13	Do you have access to irrigable land?	1. Yes 2. No
14	If your answer is **Yes**, what is the	_____ hectares

	size of your irrigable land?		
15	How much money do you get from the following sources in 20011/12 EC crop year?	**Income sources**	**Amount in Birr**
1. Livestock and livestock products sale			
2. Grain sale			
3. Poultry and its products sale			
4. Firewood and grass sale			
5. Charcoal and *kubet* (cow-dung cake) sale			
6. Local drinks sale			
7. Petty trading			
8. Rural credit			
9. Labor wage			
10. Sale of sand and stone			
11. Remittance			
12. Others (specify) _____			
13	Who is in control of the household income?	1. The husband 2. The wife 3. Both	

14. Do you use modern farm input to produce better yields? a) Yes b) No
15. If your response is 'yes' to question no14, which one do you use and in what amount?

No	**Type of input used**	**a) Yes**	**b) No**	**Amount in Kgs or liters**
1	Improved seeds			
2	Chemical fertilizer			
3	Herbicides			
4	Insecticides			
5	Others, specify			

16. How do you evaluate the condition of rainfall in your area for crop production and livestock rearing?
    a) Normal b) Sufficient c) Insufficient

17. Did you experience crop failure due to shortage of rainfall? a) Yes b) No
18. If your response is 'yes' to question no 20, please mention the main rainfall shortage years? _____
19. What was/were the consequence/s?(multiple responsible is possible)
    a) Shortage of food b) Lack of pasture
    c) Shortage of drinking water d) Others, specify
20. What are your Sources of water for household consumption and for various agricultural purposes?
    a) River b) Protected spring
    c) Unprotected spring d) Piped water e) others, specify
21. How long does it take (one way) to travel to this water source? Hour_____ minutes_____
22. What was/were the consequence/s?(multiple responsible is possible)
    a) Shortage of food b) Lack of pasture
    c) Shortage of drinking water d) Others, specify
23. What are your Sources of water for household consumption and for various agricultural purposes?
    a) River b) Protected spring
    c) Unprotected spring d) Piped water e) Others, specify

24. How long does it take (one way) to travel to this water source? Hour_____ minutes_____

25. How do you rate the current water availability for human and livestock consumption?
    a) Good b) Normal c) Sufficient
    d) Insufficient e) Others, specify

26.Do your household access to water for irrigation? a) Yes b) No

27.If your response is 'no' to question no 26, what are the main reasons?
    a) Lack of water source b) Lack of interest
    c) Lack of technical skill d) Others, specify

28. Do you have farm oxen? a) Yes b) No
29. If your response is 'yes' to question no 28, how much? in number_____
30. If your response is 'no' to question no 28, how you access?
    a) Through borrowing b) Through sharecropping
    c) Through Q*ixira* d) No means

31. Do you have other livestock, poultry, and beehives resource? a) Yes b) No

32. If your response is 'yes' to question no 31, would you tell us their number with their equivalent prices?

No	Type	Number	Equivalence in cash (in *birr*)
1	Cows		
2	Oxen		
3	Bulls		
4	Heifers		
5	Calves		
6	Sheep		
7	Goats		
8	Mules		
9	Horses		
10	Donkeys		
11	Chicken		
12	Bee Hives		

29. If you do not have, why this is so?

a. No capital to buy some b) No place to keep them

c) No person to look after d) other, specify

PART.4.Household Income, Consumption and Expenditure

1. Does any of your household members work in no-crop production and livestock herding Activities? a) Yes b) No
2. If your response is 'yes' to question no 1, would you tell us about the types of activities, persons engaged in, amount of income from the job, and the purpose for which you used the money?

No	Activity types	Member participated	Time spent per month	Estimate l annual income		Earning used for		
				cash	in kind	1st	2nd	3rd
1								
2								
3								
4								
5								

3.If your response is 'no' to question no 1, of your member works in nonfarm activities, what are their reasons for not taking the opportunity?

No	Reasons for not working	a) Yes	b) No
1	Lack of spare time from agriculture		
2	Lack of awareness about its contribution value		
3	Lack of job opportunities		
4	Unable to work due to old age		
5	Health problems		
6	Others, specify		

4.Do you afford to buy food stuffs from market for your household consumption? a) Yes b) No

5. How much money do you generate from the following sources in 2019/20 (2011/2012E.C) crop year?

No	Income sources	Estimated amount of *birr*
1	Livestock and livestock products' sale	
2	Grain sale	

3	Poultry and its products sale	
4	Eucalyptus sale	
5	Firewood and grass sale	
6	Charcoal and *kubet* sale	
7	Local drink sale	
8	Local trade	
9	Rural credit	
10	Labor wage	
11	Others, specify	

6. How much did you spend for the following purposes in 2019/20 (2011/2012E.C) crop year?

No	**Expense Type**	**Amount In Birr**
1	Grain purchase	
2	Land use tax	
3	Religious feast expenses (*senbete, teskar, mahber*)	
4	Wedding	
5	Payment of credit	
6	Purchase of modern farm input	
7	Clothing expenses	
8	School expenses	
9	Medical expenses	
10	Others, specify	

PART.5 Household Food Insecurity Access Scale (HFIAS) Measurement Tool

No	Questions	Rarely (once or twice)	Sometimes (three to ten times)	Often (more than ten times)	Code
1	In the past four weeks, did you worry that your household would not have enough food? [1] Yes [0] No				
1a	How often did this happen?				
2	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources? [1] Yes [0] No				
2a	How often did this happen?				
3	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources? [1] Yes [0] No				
3a	How often did this happen?				
4	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food? 1] Yes [0] No				
4a	How often did this happen?				
5	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food? [1] Yes [0] No				
5a	How often did this happen?				
6	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough				

	food? [1] Yes [0] No				
6a	How often did this happen?				
7	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food? [1] Yes [0] No				
7a	How often did this happen?				
8	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food? [1] Yes [0] No				
8a	How often did this happen?				
9	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food? [1] Yes [0] No				
9a	How often did this happen?				

Part .6 household dietary diversity assessing questions

Now I would like to ask you about the types of food that you or anyone else in your household are yesterday during the day and at night

Questions	Yes	No
1.Porridge, bread, rice, pasta/noodles or other foods		

made from grains		
2.Any foods made from beans, peas, lentils, nuts or seeds		
3.Infant formula, such as [insert local examples]Milk, such as tinned, powdered or fresh animal milk		
4.Any meat, such as beef, lamb, goat, chicken or other meat		
5.Eggs from poultry		
6.Pumpkin, carrots, squash or sweet potatoes that are yellow or orange inside		
7.Any other vegetables and fruits		

8.Any oil, fats, or butter or foods made with any of these		
9.Any sugary foods, such as chocolates, sweets, candies, pastries, cakes or biscuits		

PART. 7 ANTHROPOMETRIC DATA COLLECTION FORM UNDER FIVE CHILDREN

A.Checklist for Field Observation

1. Relief (plain, plateau, mountain, steep slopes)
2. Land-use and land cover
3. Soil aspects
4. Water bodies
5. Check to sanitized equipment
6. Wearing of face mask and glove
7. anthropometric indicators for infants and children measures of weight and height
8. variety and nutrient adequacy of diets for an individual of infants and children

2.Population

1. Settlement patterns
2. Infantsand children(under-five children)
3. Ethnicity
4. Religion
5. Culture, value, traditions
6. Social relations neighborhoods, network, reciprocity

3.Economy/Sources of livelihood

1. Main source of livelihood: mixed farming, non-farm activities
2. Crop types: dominant in terms of area cultivated and size of harvest during *meher*and*belg*seasons, source of staple food

3. Livestock: type, size, raising practices
4. Situations of social and economic infrastructure: transport, water, health, marketing, extension services, sources of water supply, schools, health posts.

B.Check List for Focus Group Discussions

1. Perception towards land resource change: vegetation, soils, water use and distribution.
2. Perception towards population increase (having large family size) and its advantage and disadvantage.
3. Do you observe any households who cannot cover its food need? If so, how they used to bridge the food gap?
4. Average number of months most households able to feed themselves from their own production.
5. Do you observe any individuals or group of landless people in your *kebele*? If there are, please explain how they generate their livelihoods.
6. How do you judge the fertility level of the farm land as compared to the situation some 5 years ago?
7. What look like children dietary diversity and feeding practice?
8. What are the main constraints to produce crops and raise livestock?
9. Availability of health, school, credit, water supply, market, agricultural extension and irrigation services and facilities.
10. What are the survival strategies used by people in the area to cope with food stress?

C.Checklists for Individual Interview Guides

1.Key informants – community elderly ▪Demography:

age, household composition, etc.

- Migration: birth place, stay at other place, and stay at current site
- History of the area: landscape, settlement density and patterns
- Perception towards population increase, having large family size
- Children feeding practicecaregiver knowledge and beliefs
- adequate sanitation health care availability
- Perception towards diminishing land size
- Land resource change: vegetation, soils, water use and distribution
- Land holdings at main site: for crop cultivation and grazing situation of communal land at all sites?
- Livestock possession: size and type
- Change in type of staple foods and foodstuffs
- Perception towards food shortage
- For how long does the harvest at home cover household food requirements?
- Grain purchase: during which period of a year? How much and what types per week?
- Source of cash income: sell off livestock or their products

- Is there a time of a year when your household is unable to purchase sufficient food?
- How do you survive shortage seasons (coping strategies)?
- Experience of drought: Do you remember a drought year that seriously affected your livestock and households? What happened to your livestock? How did you recover from the crises?
- What are the main constraints to raising livestock and crop production at your sites?
- Perception towards DAs and government extension packages to ensure household food security

2.In-depth interview guide for the households Demography and life history narratives for the head and other household members: a.Conditions of human capital

- Name, age
- Family size by sex caregiver physical and mental status
- Experience and perception towards large family size
- Place of birth, migration, marriage, and mortality history
- Labor demand and supply (who can work and who cannot among the members)
- Literacy and participation in formal education
- Main health problems in the community
- Health problems experienced by household members
- Are there any disable persons among the household members?

b.Access to natural capital

- Land holding size
- Ways of getting access to land
- Sharecropping in/out
- Change in holding size over the last few years
- Perceived status of farmland in terms suitability for farming and soil fertility
- Main problems of farmland
- Land management practices
- Access to water for human and livestock use
- Problems of water use
- Access to natural vegetation
- How to use, and perception towards their removal/depletion
- Problems in relation to the exploitation of natural vegetation
- Perception towards the recurrent drought and erratic rainfall distribution **c.Financial capital**
- Main annual crops grown and size of harvests during the last two years
- Trends in production (increase/decrease/no change – why)

- Perennial crops grown (size and income from their sale per year)
- Types of technological inputs under use
- Livestock owned (types and size)
- Constraints to livestock raising

d. Social capital (social relations and networking)

- Participation in informal institutions (CBOs – *hiqub*, *iddir, mahiber*,neighbourhood coffee drinking)
- Participation in labor organizations
- Labor support from neighbours, relatives
- Support in kind from kin/relatives
- Draft power assistance to/from neighbours
- Grain and Cash loan during deficit period
- Remittance from/to individuals/institutions

e.Physical capital (availability and access to rural infrastructure)

- Health service
- School
- Potable water source
- Credit
- Irrigation
- Market and fair price (for both selling and purchasing)
- Technological inputs (fertilizers, herbicides, insecticides, etc.)
- Agricultural extension
- Veterinary service
- Access and affordability of medicines for human and livestock use

f.Food security

- Main staple food crops of the households
- The type of meal eaten most frequent at home
- Average number of months you able to feed your households from own production
- What are the main bottlenecks to produce crops and raise stocks that enable you to be self-sufficient in food?
- Does the income you earn from non-farm activities allow you to buy food during shortages?

Appendix-III: Weight-for-length/height cut-off points (NACS,2016).

BOYS 0–23 months, weight-for-length

Length (cm)	SAM < –3	MAM –3 to < [illegible]	Normal –2 to ≤ [illegible]	Overweight > +2 to ≤ +3	Obesity > +3
↓	Weight (kg) →				
45	0–1.8	1.9	2.0–3.0	3.1–3.3	> 3.3
46	0–1.9	2.0–2.1	2.2–3.1	3.2–3.5	> 3.5
47	0–2.0	2.1–2.2	2.3–3.3	3.4–3.7	> 3.7
48	0–2.2	2.3–2.4	2.5–3.6	3.7–3.9	> 3.9
49	0–2.3	2.4–2.5	2.6–3.8	3.9–4.2	> 4.2
50	0–2.5	2.6–2.7	2.8–4.0	4.1–4.4	> 4.4
51	0–2.6	2.7–2.9	3.0–4.2	4.3–4.7	> 4.7
52	0–2.8	2.9–3.1	3.2–4.5	4.6–5.0	> 5.0
53	0–3.0	3.1–3.3	3.4–4.8	4.9–5.3	> 5.3
54	0–3.2	3.3–3.5	3.6–5.1	5.2–5.6	> 5.6
55	0–3.5	3.6–3.7	3.8–5.4	5.5–6.0	> 6.0
56	0–3.7	3.8–4.0	4.1–5.8	5.9–6.3	> 6.3
57	0–3.9	4.0–4.2	4.3–6.1	6.2–6.7	> 6.7
58	0–4.2	4.3–4.5	4.6–6.4	6.5–7.1	> 7.1
59	0–4.4	4.5–4.7	4.8–6.8	6.9–7.4	> 7.4
60	0–4.6	4.7–5.0	5.1–7.1	7.2–7.8	> 7.8
61	0–4.8	4.9–5.2	5.3–7.4	7.5–8.1	> 8.1
62	0–5.0	5.1–5.5	5.6–7.7	7.8–8.5	> 8.5
63	0–5.2	5.3–5.7	5.8–8.0	8.1–8.8	> 8.8
64	0–5.4	5.5–5.9	6.0–8.3	8.4–9.1	> 9.1
65	0–5.6	5.7–6.1	6.2–8.6	8.7–9.4	> 9.4
66	0–5.8	5.9–6.3	6.4–8.9	9.0–9.7	> 9.7
67	0–6.0	6.1–6.5	6.6–9.2	9.3–10.0	> 10.0
68	0–6.2	6.3–6.7	6.8–9.4	9.5–10.3	> 10.3
69	0–6.4	6.5–6.9	7.0–9.7	9.8–10.6	> 10.6
70	0–6.5	6.6–7.1	7.2–10.0	10.1–10.9	> 10.9
71	0–6.7	6.8–7.3	7.4–10.2	10.3–11.2	> 11.2
72	0–6.9	7.0–7.5	7.6–10.5	10.6–11.5	> 11.5
73	0–7.1	7.2–7.6	7.7–10.8	10.9–11.8	> 11.8
74	0–7.2	7.3–7.8	7.9–11.0	11.1–12.1	> 12.1
75	0–7.4	7.5–8.0	8.1–11.3	11.4–12.3	> 12.3
76	0–7.5	7.6–8.2	8.3–11.5	11.6–12.6	> 12.6
77	0–7.7	7.8–8.3	8.4–11.7	11.8–12.8	> 12.8
78	0–7.8	7.9–8.5	8.6–12.0	12.1–13.1	> 13.1
79	0–8.0	8.1–8.6	8.7–12.2	12.3–13.3	> 13.3
80	0–8.1	8.2–8.8	8.9–12.4	12.5–13.6	> 13.6
81	0–8.3	8.4–9.0	9.1–12.6	12.7–13.8	> 13.8
82	0–8.4	8.5–9.1	9.2–12.8	12.9–14.0	> 14.0
83	0–8.6	8.7–9.3	9.4–13.1	13.2–14.3	> 14.3
84	0–8.8	8.9–9.5	9.6–13.3	13.4–14.6	> 14.6
85	0–9.0	9.1–9.7	9.8–13.6	13.7–14.9	> 14.9
86	0–9.2	9.3–9.9	10.0–13.9	14.0–15.2	> 15.2

GIRLS 0–23 months,

Length (cm)	SAM < –3	MAM –3 to < [illegible]	Normal [illegible]	Overweight >+2 to ≤ +3	Obesity > +3
↓	Weight (kg) →				
45	0–1.8	1.9–2.0	2.1–3.0	3.1–3.3	> 3.3
46	0–1.9	2.0–2.1	2.2–3.2	3.3–3.5	> 3.5
47	0–2.1	2.2–2.3	2.4–3.4	3.5–3.7	> 3.7
48	0–2.2	2.3–2.4	2.5–3.6	3.7–4.0	> 4.0
49	0–2.3	2.4–2.5	2.6–3.8	3.9–4.2	> 4.2
50	0–2.5	2.6–2.7	2.8–4.0	4.1–4.5	> 4.5
51	0–2.7	2.8–2.9	3.0–4.3	4.4–4.8	> 4.8
52	0–2.8	2.9–3.1	3.2–4.6	4.7–5.1	> 5.1
53	0–3.0	3.1–3.3	3.4–4.9	5.0–5.4	> 5.4
54	0–3.2	3.3–3.5	3.6–5.2	5.3–5.7	> 5.7
55	0–3.4	3.5–3.7	3.8–5.5	5.6–6.1	> 6.1
56	0–3.6	3.7–3.9	4.0–5.8	5.9–6.4	> 6.4
57	0–3.8	3.9–4.2	4.3–6.1	6.2–6.8	> 6.8
58	0–4.0	4.1–4.4	4.5–6.5	6.6–7.1	> 7.1
59	0–4.2	4.3–4.6	4.7–6.8	6.9–7.5	> 7.5
60	0–4.4	4.5–4.8	4.9–7.1	7.2–7.8	> 7.8
61	0–4.6	4.7–5.0	5.1–7.4	7.5–8.2	> 8.2
62	0–4.8	4.9–5.2	5.3–7.7	7.8–8.5	> 8.5
63	0–5.0	5.1–5.4	5.5–8.0	8.1–8.8	> 8.8
64	0–5.2	5.3–5.6	5.7–8.3	8.4–9.1	> 9.1
65	0–5.4	5.5–5.8	5.9–8.6	8.7–9.5	> 9.5
66	0–5.5	5.6–6.0	6.1–8.8	8.9–9.8	> 9.8
67	0–5.7	5.8–6.2	6.3–9.1	9.2–10.0	> 10.0
68	0–5.9	6.0–6.4	6.5–9.4	9.5–10.3	> 10.3
69	0–6.0	6.1–6.6	6.7–9.6	9.7–10.6	> 10.6
70	0–6.2	6.3–6.8	6.9–9.9	10.0–10.9	> 10.9
71	0–6.4	6.5–6.9	7.0–10.1	10.2–11.1	> 11.1
72	0–6.5	6.6–7.1	7.2–10.3	10.4–11.4	> 11.4
73	0–6.7	6.8–7.3	7.4–10.6	10.7–11.7	> 11.7
74	0–6.8	6.9–7.4	7.5–10.8	10.9–11.9	> 11.9
75	0–7.0	7.1–7.6	7.7–11.0	11.1–12.2	> 12.2
76	0–7.1	7.2–7.7	7.8–11.2	11.3–12.4	> 12.4
77	0–7.3	7.4–7.9	8.0–11.5	11.6–12.6	> 12.6
78	0–7.4	7.5–8.1	8.2–11.7	11.8–12.9	> 12.9
79	0–7.6	7.7–8.2	8.3–11.9	12.0–13.1	> 13.1
80	0–7.7	7.8–8.4	8.5–12.1	12.2–13.4	> 13.4
81	0–7.9	8.0–8.6	8.7–12.4	12.5–13.7	> 13.7
82	0–8.0	8.1–8.7	8.8–12.6	12.7–13.9	> 13.9
83	0–8.2	8.3–8.9	9.0–12.9	13.0–14.2	> 14.2
84	0–8.4	8.5–9.1	9.2–13.2	13.3–14.5	> 14.5
85	0–8.6	8.7–9.3	9.4–13.5	13.6–14.9	> 14.9
86	0–8.8	8.9–9.6	9.7–13.8	13.9–15.2	> 15.2

weight-for-

Length

BOYS 24–59 months, weight-for-height					
Height (cm)	SAM < –3	MAM ≥ –3 to < –2	Normal ≥ –2 to ≤ +2	Overweight > +2 to ≤ +3	Obesity > +3
	Weight (kg)				
89	0–9.9	10.0–10.7	10.8–14.9	15.0–16.3	> 16.3
90	0–10.1	10.2–10.9	11.0–15.2	15.3–16.6	> 16.6
91	0–10.3	10.4–11.1	11.2–15.5	15.6–16.9	> 16.9
92	0–10.5	10.6–11.3	11.4–15.8	15.9–17.2	> 17.2
93	0–10.7	10.8–11.5	11.6–16.0	16.1–17.5	> 17.5
94	0–10.9	11.0–11.7	11.8–16.3	16.4–17.8	> 17.8
95	0–11.0	11.1–11.9	12.0–16.6	16.7–18.1	> 18.1
96	0–11.2	11.3–12.1	12.2–16.9	17.0–18.4	> 18.4
97	0–11.4	11.5–12.3	12.4–17.2	17.3–18.8	> 18.8
98	0–11.6	11.7–12.5	12.6–17.5	17.6–19.1	> 19.1
99	0–11.8	11.9–12.8	12.9–17.9	18.0–19.5	> 19.5
100	0–12.0	12.1–13.0	13.1–18.2	18.3–19.9	> 19.9
101	0–12.2	12.3–13.2	13.3–18.5	18.6–20.3	> 20.3
102	0–12.4	12.5–13.5	13.6–18.9	19.0–20.7	> 20.7
103	0–12.7	12.8–13.7	13.8–19.3	19.4–21.1	> 21.1
104	0–12.9	13.0–13.9	14.0–19.7	19.8–21.6	> 21.6
105	0–13.1	13.2–14.2	14.3–20.1	20.2–22.0	> 22.0
106	0–13.3	13.4–14.4	14.5–20.5	20.6–22.5	> 22.5
107	0–13.6	13.7–14.7	14.8–20.9	21.0–22.9	> 22.9
108	0–13.8	13.9–15.0	15.1–21.3	21.4–23.4	> 23.4
109	0–14.0	14.1–15.2	15.3–21.8	21.9–23.9	> 23.9
110	0–14.3	14.4–15.5	15.6–22.2	22.3–24.4	> 24.4
111	0–14.5	14.6–15.8	15.9–22.7	22.8–25.0	> 25.0
112	0–14.8	14.9–16.1	16.2–23.1	23.2–25.5	> 25.5
113	0–15.1	15.2–16.4	16.5–23.6	23.7–26.0	> 26.0
114	0–15.3	15.4–16.7	16.8–24.1	24.2–26.6	> 26.6
115	0–15.6	15.7–17.0	17.1–24.6	24.7–27.2	> 27.2
116	0–15.9	16.0–17.3	17.4–25.1	25.2–27.8	> 27.8
117	0–16.1	16.2–17.6	17.7–25.6	25.7–28.3	> 28.3
118	0–16.4	16.5–17.9	18.0–26.1	26.2–28.9	> 28.9
119	0–16.7	16.8–18.2	18.3–26.6	26.7–29.5	> 29.5
120	0–17.0	17.1–18.5	18.6–27.2	27.3–30.1	> 30.1

GIRLS 24–59 months, weight-for-height					
Height (cm)	SAM < –3	MAM ≥ –3 to < –2	Normal ≥ –2 to ≤ +2	Overweight > +2 to ≤ +3	Obesity > +3
	Weight (kg)				
89	0–9.5	9.6–10.3	10.4–14.9	15.0–16.4	> 16.4
90	0–9.7	9.8–10.5	10.6–15.2	15.3–16.8	> 16.8
91	0–9.9	10.0–10.8	10.9–15.5	15.6–17.1	> 17.1
92	0–10.1	10.2–11.0	11.1–15.8	15.9–17.4	> 17.4
93	0–10.3	10.4–11.2	11.3–16.1	16.2–17.8	> 17.8
94	0–10.5	10.6–11.4	11.5–16.4	16.5–18.1	> 18.1
95	0–10.7	10.8–11.6	11.7–16.7	16.8–18.5	> 18.5
96	0–10.8	10.9–11.8	11.9–17.0	17.1–18.8	> 18.8
97	0–11.0	11.1–12.0	12.1–17.4	17.5–19.2	> 19.2
98	0–11.2	11.3–12.2	12.3–17.7	17.8–19.5	> 19.5
99	0–11.4	11.5–12.4	12.5–18.0	18.1–19.9	> 19.9
100	0–11.6	11.7–12.7	12.8–18.4	18.5–20.3	> 20.3
101	0–11.9	12.0–12.9	13.0–18.7	18.8–20.7	> 20.7
102	0–12.1	12.2–13.2	13.3–19.1	19.2–21.1	> 21.1
103	0–12.3	12.4–13.4	13.5–19.5	19.6–21.6	> 21.6
104	0–12.5	12.6–13.7	13.8–19.9	20.0–22.0	> 22.0
105	0–12.8	12.9–13.9	14.0–20.3	20.4–22.5	> 22.5
106	0–13.0	13.1–14.2	14.3–20.8	20.9–23.0	> 23.0
107	0–13.3	13.4–14.5	14.6–21.2	21.3–23.5	> 23.5
108	0–13.6	13.7–14.8	14.9–21.7	21.8–24.0	> 24.0
109	0–13.8	13.9–15.1	15.2–22.1	22.2–24.5	> 24.5
110	0–	14.2–15.4	15.5–22.6	22.7–25.1	> 25.1

	14.1				
111	0–14.4	14.5–15.7	15.8–23.1	23.2–25.7	> 25.7
112	0–14.7	14.8–16.1	16.2–23.6	23.7–26.2	> 26.2
113	0–15.0	15.1–16.4	16.5–24.2	24.3–26.8	> 26.8
114	0–15.3	15.4–16.7	16.8–24.7	24.8–27.4	> 27.4
115	0–15.6	15.7–17.1	17.2–25.2	25.3–28.1	> 28.1
116	0–15.9	16.0–17.4	17.5–25.8	25.9–28.7	> 28.7
117	0–16.2	16.3–17.7	17.8–26.3	26.4–29.3	> 29.3
118	0–16.5	16.6–18.1	18.2–26.9	27.0–29.9	> 29.9
119	0–16.8	16.9–18.4	18.5–27.4	27.5–30.6	> 30.6
120	0–17.2	17.3–18.8	18.9–28.0	28.1–31.2	> 31.2