ASSESSMENT OF TRENDS AND DETERMINANTS OF HOUSEHOLD FOOD INSECURITY IN MARSABIT COUNTY-KENYA

BY

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DECLARETION

I declare that this research project has not been presented anywhere for any award and that all sources of information have been acknowledged by means of references.

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EL/SPM/01258/2017

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DEDICATION

I dedicate this work to my lovely wife and children.

ABSTRACT

Food insecurity is a growing concern worldwide despite the government strategies to implement measures. However, a lot of studies conducted so far in the field gave more emphasis to the high potential counties of Kenya. Better understanding of major determinants and trends of household food insecurity is important to design appropriate interventions. In Marsabit County, food insecurity has been exacerbated by multiple hazards such drought, COVID-19 pandemic, conflict and desert locust invasion. A lot of studies have been conducted in the field of food insecurity but such assessments do not verify situations in Marsabit and hide the true determinants, trends and prevalence of food insecurity. The purpose of the study was to assess trends and determinants of household food insecurity in Marsabit County. The study was guided by the following objectives: to assess temporal variation of food insecurity in the period 2017-2020 in Marsabit County, to estimate the prevalence of food insecurity in Marsabit County and to identify the key determinants household food insecurity in Marsabit County. The study adopted cross sectional descriptive research design where primary data was gathered at the household level and triangulated with secondary data from National Drought Management Authority. In this research, monthly sentinel data collected by NDMA in the period 2017-2020 was used to understand the temporal variation/trends of food insecurity in the area. Furthermore, primary data collection was implemented to understand the current determinants and prevalence of household food insecurity. Purposive sampling was used to select the pre sampled wards and thereafter simple random sampling applied to select households from the pre sampled wards. A total of 322 households were interviewed across the pre sampled wards from a target sample size 399 households which represented 81% response rate. Primary data was collected through structured questionnaires. Factors of household food insecurity were livestock owned, livestock prices, educational level, milk production, milk consumption, main sources of income, water sources, and household and livestock water distances. Five food security outcome indicators were assessed: Reduced Coping Strategies Index; Household Hunger Scale; Food Consumption Score; the Household Dietary Diversity Scale and Food Insecurity Experience Scale. For objective 1; Time series plots were applied on food security outcomes to determine temporal variation of food insecurity in the period 2017-2020 in Marsabit County. For objective 2; proportion of the food insecurity outcomes was computed so to estimate the prevalence of food insecurity and in objective 3, ordinal logistic regression models adopted to identify determinants of household food insecurity. Overall prevalence of household food insecurity was moderate. Spikes of food insecurity were witnessed in a good year of 2020. Although the mean food consumption score fell outside the normal ranges, households had minimal food consumption gaps and adopted coping mechanisms were less frequent and severe. Household hunger was at moderate levels during the study period. Tertiary training, university degree, sale of livestock, sale of crops and water sources such as natural ponds and shallow wells were significant and thus showed a relationship with food consumption score. University educational level of household head, sale of livestock, trade and sources of water for households such as water pans, piped water, traditional river wells and seasonal rivers were significant thus showed an association with the predicted variable coping strategy index.

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LIST OF ABBREVIATIONS AND ACRONYMS

ARIMA	Auto-Regressive Integrated Moving Average
ASALs	Arid and Semi-Arid Lands
CSI	Coping Strategy Index
FAO	Food and Agricultural Organization
FCS	Food Consumption Score
FEWS	Famine Early Warning System
FIES	Food Insecurity Experience Scale
HDDS	Household Dietary Diversity Score
HFIAS	Household Food Insecurity Access Scale
HHS	Household Hunger Scale
IPC	Integrated Phase Classification
KFSSG	Kenya Food Security Steering Group
MUAC	Mid-Upper Arm Circumference
NDMA	National Drought Management Authority
NGOs	Non- Governmental Organizations
UN	United Nations
WFP	World Food Programme

OPERATIONAL DEFINITION OF TERMS

Coping strategies of food insecurity- A measure of the impact of food aid programmes, as an early warning indicator of impending food crisis for assessing both food aid needs and whether food aid has been targeted to the most food insecure households.

Determinants-a factor which decisively affects the nature or outcome of something.

Ecosystem- complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space.

Effect- A change which is a result or consequence of an action or other cause.

Factors-Circumstances, facts, or influences that contributes to results.

Food Security- People, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

Household- refers to a family or group of people living together. It's a social unit under one roof. All the people living in your house, including servants, make up your household.

Integrated Phase Classification 3 (Crisis)- Households either have food consumption gaps that are reflected by high or above-usual acute malnutrition or are marginally able to meet minimum food needs but only by depleting essential livelihood assets or through crisis.

Integrated Phase Classification 4 (Emergency)-Households have food consumption gaps that are reflected by very high acute malnutrition and are not able to meet minimum food needs.

Livelihood Zone- Geographical area within which people share basically the same patterns of access to food and income (that is, they grow the same crops, or keep the same types of livestock), and have the same access to markets.

Prevalence-Prevalence is a statistical concept referring to the proportion of caseloads in a given parameter in a particular population at a given time.

Project - this is a specific activity to be carried out, which consumes resources and has a beginning and an end.

Temporal Variation-Variability of indicators/behavioral change over time.

Trends-Practice of collecting information and attempting to spot a pattern. Refers to techniques for extracting an underlying pattern of behavior in a time series which would otherwise be partly or nearly completely hidden by noise.

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CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Food insecurity is a growing concern worldwide despite the government strategies to implement measures and various monitoring frameworks. The process to fight against hunger, is yet to be achieved and a number of households still lack basic food to sustain themselves. The need for an active and healthy life in major cities and the rural households has not been achieved, since most families fail to get a dollar a day to sustain their households. (*Management*, *4*(1) Shariff, Z. M., & Khor, G. L. (2008). The latest available estimates indicate that about 795 million people in the world - just over one in nine - were undernourished in 2014-16, down 167 million over the last decade, and 216 million lower than in 1990-92 despite massive investments that had been undertaken overtime (FAO, 2015). In the same period, the prevalence of undernourishment had decreased from 18.6% to 10.9% globally, reflecting fewer undernourished people in a growing global population (FAO, 2015) thus was mostly attributed to food security contributing factors of availability and access. Efforts to introduce farming techniques to these communities have failed since they do not embrace agriculture due to their pastoral way of life and the climatic conditions that is not favourable to the farming activities. Despite this overall progress in developing countries as a whole, there is still considerable room to improve food security, the intervention by most non-governmental organizations and their established monitoring frameworks are still going through challenges. In United States of America, Blumberg *et al.* (1999) alluded that despite the fact that there are adequate supplies of food in the USA, various households still lack access to enough food.

In Africa as a whole and sub-Saharan Africa in particular, progress has been slow towards the international hunger targets. In Sub-Saharan Africa, about 220 million hungry people just under one in every four people, or 23.2% of the population, were estimated to be undernourished in 2014-16. In fact, the number of undernourished people even increased by 44 million between 1990-92 and 2014–16. Taking into account the region's declining prevalence of undernourishment; this reflects the region's remarkably high population growth rate of 2.7% per year (FAO, 2015). This is attributed to the increase in extreme climate events that have far reaching impacts on agricultural production, food insecurity, water availability, energy resources and biodiversity (Kadi *et al*., 2011).In South Africa, the food insecure people have opted to

changing their food consumption patterns and diversification to curb hunger (Oldewage-Theron *et al*., 2006). The feeding patterns are only short-lived and does not favour most families since they may not afford a meal for their house households. In the Eastern African region, Regassa (2011) evaluated the food insecurity coping strategies for the small holder households in southern Ethiopia and established that they embraced migration for their survival.

Several authors have investigated the determinants of food security in sub-Saharan Africa. Nyangwesoi et al. 9 in a study of household food security in Vihiga district of Kenya found that household income, number of adults, ethnicity, savings behaviour and nutrition awareness significantly influence household food security. In a similar study, Kahoi et al. 10 established that the significant determinants of food security in the Mwingi district of Kenya were participation of households in the food for work program, marital status of the household head and their educational level. In a study of food security in the Lake Chad Area of Borno State, Nigeria, Goni 11 reported that factors influencing household food security, including household size, stock of home produced food and number of income earners in the household, were positively related to food security. In addition, in a study of food security in Nigeria, Olayemi 12 categorized factors affecting food security at the household level into supply-side factors, demand-side factors and stability of access to food, which includes household food and non-food production variability; household economic asset; household income variability; quality of human capital within the households; degree of producer and consumer price variability and household food storage and inventory practices.

A host of factors, including natural and man-made, have resulted in the growing food insecurity problem in many parts of Kenya especially the arid and semi-arid lands. Frequently recurring droughts and erratic rainfall patterns, land degradation, rapid population growth, and poor rural infrastructure have also been cited as some of the causes of food insecurity and widespread poverty in the country. Other factors contributing to food insecurity are the low levels of technology employed in agriculture and the resulting low productivity of the sector (Sabates-Wheeler et al. 2012).Myriad of food security related interventions have been undertaken by the National Government, County Government and Non-State Actors in Marsabit County, however, food insecurity still persists thus the need to integrate monitoring on the activities that are geared towards addressing food security at the community level. Marsabit County is characterized by

limited water resources constantly liable to unpredictable climatic shocks leading to massive crop failures, abnormal livestock migration, high malnutrition levels for children and pregnant and lactating women, high food prices, markets disruptions, prolonged livestock generation intervals and livestock mortalities in addition to other hazards such as drought, COVID-19, insecurity and desert locust invasion hence low resilience levels and high food insecurity. Factors considered for household food insecurity in the ASALs of Kenya are livestock owned, livestock prices, milk production, milk consumption, main sources of income, water sources, household and livestock water distances and food security outcomes of coping strategies, food consumption, household insecurity experience scale, household hunger scale and household dietary diversity score (KFSSG, 2010).

In Marsabit County, food insecurity has met varied climatic challenges and variability in community livelihoods through hazards that are historically familiar. However, with increasing intensities and frequencies of the hazards particularly drought, the existing adaptive and coping capacities are often over-stretched making it necessary to either revise or develop new suitable food security strategies that can cope with the magnitudes since the government efforts have not been achieved. Although various policy measures have been designed to address the problem, and despite the implementation of major market liberalization in the country as well as surpluses in food grain production in recent years, there have been reports that food availability still remains at low levels and food insecurity persists. It is against this background that this study was undertaken to examine trends and determinants of household food insecurity in the period 2017-2020 in Marsabit County. Majority of the research works that have been done so far on the issues related to food insecurity in Marsabit County are very general and consider the problem from national or county points of view.

While aggregate data are generally available at the national level, little work has been done to understand the food security problem at the household level in at the local level. Having national food balance data is not sufficient to understand the food security dynamics in Marsabit County. Despite the increasing national concern of improving food security, the nature and extent of food security at the household level in Marsabit County is not well documented. Numerous studies have analyzed trends and factors that determine food security in Marsabit County. Per capita land holding, livestock availability, education, household per capita income from agricultural and

non-agricultural activities, soil fertility, and conflicts have been some of the major and commonly cited factors in the literature (Gebre-Selassie 2005, Negatu2004, Ramakirshina and Demeke 2002, Madeley 2000). However, the findings have been quite mixed and conflicting. Moreover, despite the depth of the problem of food insecurity in Marsabit County, there is relatively little empirical research on the subject. Hence, the current study attempts to fill this deficit by analyzing the trends, prevalence and determinants of food insecurity (reduced coping strategies index, household hunger scale, food consumption score, household dietary diversity scale and food insecurity experience scale in Marsabit County.

1.2 Statement of the Problem

Household food insecurity is determined by myriad of factors in the globe. Despite being the leading economy in East Africa, as well as a regional business center, Kenya has still not managed to eradicate extreme poverty and hunger. Kenya's economy enjoys the extensive sector of agriculture and livestock and even engages in the export market but nonetheless Kenyans suffer from chronic food insecurity. In Marsabit County, food insecurity is a constant challenge and the present food crisis is powered by multiple factors which are altering the concept of food affordability in the County. In Marsabit County, the effects of climate variability and change on community livelihood occur through hazards such as drought, conflict and desert locust invasion that are historically familiar. These hazards have been sources of vulnerabilities to food insecurity in Marsabit County. With increasing intensities and frequencies of hazards in Marsabit County, there were existing low adaptive and coping capacities that often over-stretched making it necessary to either revise or develop new apposite strategies that can cope with the hazard events.

Understanding the trends of food insecurity over time can provide insights and patterns that can help develop strategies to mitigate against food insecurity. Both chronic and transitory problems of food insecurity are widespread and severe at the national level. However, a lot of studies conducted so far in the field give more emphasis to the high potential counties of Kenya. But such partial assessments do not verify situations in the Arid and Semi-Arid counties moreso Marsabit and hide the true determinants and trends of food insecurity problems. Furthermore, such studies do not look at the prevalence and trends of food insecurity of household in Marsabit county. Therefore, in order to combat food insecurity in Marsabit County, detailed understanding

of the determinants, trends and prevalence of households to food insecurity is critical and this will contribute to literature gap at the local level for designing appropriate food security policy.

1.3 Objectives of the study

1.3.1 Main Objective

The main objective of the study was to assess trends and determinants of household food insecurity in the period 2017-2020 in Marsabit County

1.3.2 Specific Objectives

i. To assess temporal variation of food insecurity in the period 2017-2020in Marsabit County, Kenya.
ii. To estimate the prevalence of food insecurity in Marsabit County, Kenya.
iii. To identify the key causes of household food insecurity in Marsabit County, Kenya.

1.4 Research Questions

i. What are the patterns of food insecurity in Marsabit County during the period 2017-2020?
ii. What is the prevalence of food insecurity in Marsabit County, Kenya?
iii. What are the causes of household food insecurity in Marsabit County, Kenya?

1.5 Justification of the Study

This study was prompted by the fact that food security is a national concern and limited studies have been done linking trends and determinants to household food security in Marsabit County. It was therefore; unclear of their contribution to food security hence, a study on these patterns in Marsabit County was appropriate. This was because it provided insights into the influence of these factors on household food security. The ability to accurately measure the extent or magnitude and severity of trends and prevalence on household food security made it realistic and robust in solving this research problem. This research focused on assessing critical factors on household food insecurity in Marsabit County. This study was conducted in Marsabit County because of the massive investments by the National Government, County Government, UN Agencies and Non-State Actors which have been undertaken in Marsabit County yet acute food insecurity persists within the local communities. It was my hope that this study was to bridge the knowledge gap that had eluded a full disclosure of the problem for so long.

1.6 Scope and Limitations of the Study

This study was conducted in Marsabit County. Some parts of the study area showed likelihood of conflict among ethnic groups. This study didn't envision such spots now although, it was important that consultation with local County Governments and Security Administration be maintained frequently. To mitigate these instances of non-response, the study proposed the adoption of self-administered questionnaires through local enumerators trained on data collection who administered the questionnaires. Studies done in Marsabit are often expensive and require good logistical support due to high temperatures and long distances covered when traveling. Based on the available costs, the research fieldwork data collection took 20days in Marsabit County.

CHAPTER TWO

LITERATURE REVIEW

2.1Temporal Variation/Trends of Food Insecurity

Food is a basic need contributing to the health, productivity, survival and well-being of people. Unintentional and regular absence of food consumption has adverse health effects that include serious damage to the physical and mental state of a person (Faye et al, 2011). Widespread hunger and food unavailability also pose social problems that promote crime and insecurity actions that divert attention away from priority areas. Anxiety about food in a country could undermine economic growth and people's welfare. When people go without eating food for some time they become hungry. The whole spectrum of experience from uncertainty and anxiety about food to hunger and malnutrition is described as food insecurity.

According to the 1996 World Food Summit, food security represents "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, 1996). In the literature, food security is premised on three pillars: availability, access, and utilization. Food availability is necessary but not sufficient condition for access, while access is in turn a necessary but not sufficient condition for effective utilization (Barrett, 2010). Thus, food insecurity is experienced when people or a section of people lack physical and economic access to "sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life".

According to the Food and Agriculture Organization (FAO) of the United Nations (FAO 2003), 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. In 2010, an estimated 925 million people were affected by undernourishment globally (FAO 2011), an increase from the 848 million estimated in 2007. Despite a marked growth in global food production in the past half-century, more than one in seven people today still do not have access to basic dietary requirements and sufficient protein and energy input (Godfray et al. 2010). South Asia and Sub-Saharan Africa are the regions most affected by unreliable food access and undernourishment (Spielman et al. 2010), with 30 % of world hunger concentrated in the latter region alone (FAO 2011). Given the extent of

undernourishment in Africa, a quantitative and detailed assessment of the present production–consumption balance situation and its historical trends is necessary to understand the main issues underlying the African food security crisis. A study conducted by Abebaw (2003), revealed that Ethiopia had turned from a food exporter into a food importer during the period 1955-1959. It was not something amazing in the 1960s and 1970s to talk Ethiopia as having the potential to be the bread basket of the Middle East. It took two devastating famines for the "bread basket" since the 'hidden famine' of 1973–74, which claimed many thousands of lives, Thereafter, the Ethiopian government had recently tried to emerge from emergency responses for food insecurity to more sustainable one, by the introduction of productive safety net program that would lead one of the exemplary mechanisms in sub-Saharan countries (Food Security Strategies [FSS], 2002). Such condition in Ethiopia leads to a shift between chronic and acute food insecurity expressed by broad and deep crisis, which often is the characteristic of drought prone areas with low and variable rainfall, high population density and low natural resource endowments. Since the country is dependent on agriculture, crop failure usually leads to household food deficit. The absence of off-farm income opportunities, and delayed food aid assistance, leads to asset depletion and increasing levels of destitution at household level. Over the last fifteen years this situation has resulted in importing an average of 700-thousand metric tons of food aid per annum to meet food needs (Tafere, 2009).

Literature regarding Ethiopian catastrophic famines such as the 1973 and 1984/85 seems to be voluminous. Nevertheless, proper "transitory food insecurity" has received little attention, despite its prevalence even in what we call "normal years" as well as in the so called "high potential" and "surplus areas" (HHFSO, 2007). It maintained that in Ethiopia there two susceptible areas concentrated along two broad belts, generally described as drought and famine prone areas. One of these is the mixed farming production system area of highland Ethiopia, involving central and northeastern highlands stretching from Northern Shewa through Wello into Tigray. The land resources mainly the soils and vegetation of this part of the country have been highly degraded because of the interplay between some environmental and human factors such as relief, climate, population pressure and the resultant over-cultivation of the land, deforestation of vegetation and overgrazing. The second belt is the range-based pastoral economy of lowland Ethiopia, ranging from Wello in the north through Hararghe and Bale to Sidamo and GamoGofa in the south. Apparently, this belt is generally considered as resource poor with limited potential

and hence highly vulnerable to drought (HHFSO, 2007). Kenya is one of the countries in Eastern Africa threatened by food insecurity. The Famine Early Warning Systems Network (FEWS NET, 2012) reported over 10 million people to suffer from chronic food insecurity and poor nutrition in 2012 which is about one third of the 39 million people in Kenya reported to suffer from chronic food and nutrition insecurity (FEWS NET,2013). This was demonstrated by the 2012 military recruitment exercise which experienced a shortage of recruits due to the negative impact of the endemic food shortages on the growth of youths in some of the arid and semi-arid lands (ASALs) in Kenya (Daily Nation Newspaper, 20thAugust, 2012). While this could be attributed to many factors; the most affected areas were those that suffer frequent food shortages and depend on food aid due to drought. Therefore, adverse climatic conditions inhibit food availability (World Food Programme, 2009). Adewuyi (2002)identified climatic factors, especially, climate change leading to adverse and erratic weather patterns to inhibit food security in Nigeria. Similarly, the main causes of household food insecurity in Uganda are inadequate rainfall, pests and diseases, and excessive rain (Morse et al.,2009). Sseguya (2009) attributed decreased production per unit area of land in Uganda to erratic and adverse weather conditions. Therefore, living in a region characterized by average annual rainfall, humidity, cloud cover and high day temperature in rural Nigeria increases the likelihood of being food secure (Oni & Fashogbon, 2012). For example, rural Central, a high rainfall zone has consistently recorded the least food insecurity (31.4%) while the North Eastern and Lower Eastern Kenya recorded the highest food poverty of 66% and 45.2% respectively (GOK, 2006).Therefore, food security for a particular region varies by agro–climatic conditions.

According to the January 2017 Kenya Food Security Steering Group (KFSSG) short rains assessment, which included FEWSNET, large areas of the country are facing Crisis (IPC Phase 3) acute food security outcomes and atypical high food assistance needs, mainly in the pastoral and marginal agricultural areas, following the poor October – December 2016 rainy season. An atypical deterioration of acute food insecurity was experienced in the majority of pastoral areas, including northwestern, northeastern, northern, and southeastern regions between February and April, with many poor households falling in the Crisis (IPC Phase 3) acute food insecurity outcomes. Some localized poor household's parts of Marsabit, Turkana, Samburu, and Garissa experienced Emergency (IPC Phase 4) outcomes in the absence of emergency food assistance. Additionally, while many northern pastoral areas of Kenya have frequently experienced

"Critical" levels of acute malnutrition in recent years, the "Critical" and "Extremely Critical" levels of acute malnutrition currently observed in northern areas were very important to note for response purposes. Coastal and southeastern marginal agricultural areas experienced atypical decline in food security due to the significantly below-average short rains crop production, depleted food stocks, and reduced on-farm casual labor opportunities. Some households in parts of Kilifi and Lamu experienced Crisis (IPC Phase 3) acute food insecurity outcomes through April, and between July and September, while the other marginal agricultural areas remained in the Stressed phase(IPC Phase 2). According to the January 2021 Kenya Food Security Steering Group (KFSSG) short rains assessment, majority of the counties across were classified to have remained in IPC phase two as it was from the food security assessment conducted in August 2020, there were significant changes observed in Turkana, Marsabit, Isiolo Parts of Samburu, Wajir and Mandera counties depicting a worsened situation to crisis. For the areas which remained in IPC phase two, mostly counties in the South East Marginal Agriculture livelihood cluster including Kitui, Makueni, and parts of the North east Pastoral livelihood cluster including Tana river.

The number of people facing acute food insecurity is estimated at 1.4 million an increase from 739,000 reported during 2020 long rains assessment and therefore requiring food assistance. Out of 1.4 million, it is estimated that 238,000 people are in emergency phase (IPC phase 4) spread across eight counties (Mandera, Wajir, Garissa, Tana River, Marsabit, Samburu, Turkana and Isiolo) with the rest in Crisis phase (IPC phase 3). The increase in numbers is attributed to below normal performance of the short rains thus impacting negatively on already fragile food security situation in the ASALs. Moreover, the situation is expected to further deteriorate during the March- May long rains season with an estimated 2 million people likely to experience acute food insecurity. For the last two decades in particular, Kenya has become increasingly reliant on food aid to meet national food deficits. In 1999-2001, external food aid made up just over 36% of the total food availability in country. Over the last decade, this has declined to an average of 10% of the volume of national cereal production (MoA, 2018).

Factors that affect household food security in various developing countries especially in Africa have been documented in some literature and these factors or determinants are most often than not location-specific (i.e. different study areas were found to have variant attributes as food

security determinants with some attributes recurring). The study conducted in Nigeria by Oluwatayo (2008) using probit model found out that sex of household head, educational level, age and income have positive influence on food security whereas household size has negative influence on household food security. Study by Sikwela (2008) in South Africa using logistic regression model showed that per aggregate production, fertilizer application, cattle ownership and access to irrigation have positive effect on household food security whereas farm size and household size have negative effect on household food security. Our study aimed to help fill the knowledge gap on food insecurity among households in Marsabit County by documenting trends of food insecurity outcomes. Limited research has been undertaken to assess the temporal variation of food insecurity outcome indicators such as FCS, HDDS, CSI, FIES and HHS in Marsabit County and therefore the rapid fluctuations of these indicators and their underlying reasons for those isolated abnormalities have not been examined overtime.

2.2 Prevalence of Food Insecurity Status

Food insecurity is a state in which individuals or households have insufficient and uncertain ability to acquire in a socially acceptable manner nutritionally adequate safe foods in sufficient quantities for an active and healthy life for all members of the household. In the United States, the concept of food insecurity is taken beyond lack of physical and economic access and utilization of food to include perceptions of food insufficiency, inadequacy, unacceptability, uncertainty and unsustainability of food. A key step in food security analysis is finding an appropriate prevalence. In the literature, there are several indicators that are used as a measure of food security. Webb et al. (2006) highlight the lack of precise measures of household food security and that the most commonly used measures of food security are based on proxy measures. In particular, measures of the 'access' dimension of food security have centered on agricultural productivity and food shortage. Food intake may be currently adequate but concerns over future intake may render a person food insecure. Thus, food insecurity here has been defined as "the inability to acquire or consume an adequate quality or sufficient quantity of food in socially acceptable ways, or the uncertainty that one will be able to do so" (Wolfe and Frongillo, 2001). Food insecurity is a "dynamic experience" with several consequences depending on severity. At the lowest level is uncertainty and anxiety about food availability in adequate quantity; while at the highest is hunger. Although food insecurity is a universal experience, different locations of the world emphasize different aspects of it. This makes food

insecurity a difficult concept to measure universally at the household or individual level (Headey and Ecker, 2012). Numerous studies have addressed the question of prevalence of food insecurity indicators. Several different categories of food insecurity measures have been developed, e.g., measures of nutritional status, caloric intake, dietary diversity, behaviors or experience, expenditure, and self-assessment measures (Cafiero et al. 2014; Barrett 2010; Cafiero 2012; Coates 2013; Carletto et al. 2013; Headey and Ecker 2013; Maxwell et al. 2014; Vaitla et al. 2015; Upton et al. 2016). Unfortunately, there is currently no "gold standard," clinical or otherwise, by which to judge the validity and reliability of these indicators (Coates 2013).Individual dietary diversity intake measures are usually too costly, both in terms of time and money, to be used for most applications beyond basic research; even when carried out, evidence suggests that these measurements often underestimate energy intake (Arsenault2015).Indicators based on the frequency of food groups consumed and behavioral/experiential measures have emerged as the two most common classes of food insecurity prevalence—largely because they are feasible in practice—but they can produce very different estimates of the prevalence of food insecurity (Maxwell et al. 2014; Headey and Ecker 2013).

Defining and interpreting food security, and measuring it in reliable, valid and cost-effective ways have proven to be stubborn problems facing researchers and programs intended to monitor food security risks (Wolfe and Frongillo, 2001). Measures of food insecurity are urgently required for purposes of prospective status of at-risk populations. Different measures are often used interchangeably, without a good idea of which dimensions of food security are captured by which measures, resulting in potentially significant misclassification of food insecure populations. The specific objective is to compare how measures of food security portray static and dynamic food security among the same sample population of Marsabit County. Five food security outcomes were assessed: The Reduced Coping Strategies Index (rCSI); Household Hunger Scale (HHS); Food Consumption Score (FCS); the Household Dietary Diversity Scale (HDDS) and Food Insecurity Experience Scale (FIES). These indicators might provide very different estimates of the prevalence of food insecurity, and their correlation will be examined. However, the indicators have also some challenges e.g the indicators differ in the underlying aspect of food security they attempt to capture, each indicator is likely only sensitive within a certain severity range of food insecurity and these ranges do not always overlap and

categorization of the prevalence of food insecurity is strongly dependent on the choice of cut-off points. For valid reasons, "food insecurity" has no accepted gold standard metric against which individual indicators can be gauged, though without one it is difficult to say which indicator performs "best" in correctly and reliably identifying food insecure households. The implication is that using more than one indicator is advisable, and policy makers should be aware of what elements of food insecurity each indicator portrays.

While food insecurity describes the state of a household's livelihood at a particular point in time, vulnerability is a "forward looking" concept that describes how susceptible individuals and households are to being unable to cope with risks associated with uncertain adverse events that may happen to them such as drought (Ellis, 1998; Bogale, 2012). Adger (2006) portrays vulnerability in terms of exposure and defenselessness in the event of harm arising from environmental and social change and lack of capacity to adapt to the change. Vulnerability to food insecurity is conditional on risk factors (Scaramozzino, 2006).

Objective measures of food insecurity as a whole are inadequate in assessing uncertainty, anxiety and vulnerability components of food insecurity. Some of them (e.g., stunting and growth status) are an indirect outcome of not just food insecurity but also other factors such as health, child care and sanitation. Coping or food management strategies may be early indications of future food insecurity but not food insecurity indicators (Wolfe and Frongillo, 2001). Due to these weaknesses, perceptions-based measures are gaining ground in food insecurity research. After identifying the target population and its characteristics or behaviors, the researcher asks subjective/experiential questions to capture food inadequacy, lack of dietary diversity in food consumed, anxiety about food unavailability and socio-cultural unacceptability of food consumed. The responses are scored in a scale and criteria set based on the scale to determine food insecure households and the extent of their insecurity.

Looking specifically at rapid field measures, several recent studies have confirmed a significant correlation between the Food Consumption Score (FCS)—a food frequency measure developed by the World Food Programme (WFP)—and caloric consumption, but degrees of correlation across contexts vary, and it often underestimates the prevalence of food insecurity (IFPRI 2008, Coates et al. 2007).One recent field validation test conducted in Latin America found that the proposed "universal" thresholds for the FCS were badly misclassifying food insecurity (defined

in that study as caloric adequacy)—but also found that conducting field validation tests everywhere would be prohibitively expensive, putting into question whether thresholds could actually be considered universal, even while validating the FCS measure in terms of correlation with other indicators (WFP 2010). A series of articles outlined the development of a Coping Strategies Index that correlates with both caloric intake and other measures of food access (Maxwell 1996; Maxwell et al. 1999; Maxwell, Caldwell, and Langworthy 2008). A different strand of research outlines the development of the Household Food Insecurity Access Scale (Coates, Swindale, and Bilinsky 2006; Webb et al. 2006). Recently, there has also been a rise in self-assessments of food security status, as noted by Headey (2011, 2013).

These measures capture food security indirectly, by measuring behaviors related to food consumption. Perhaps the best known example is the Coping Strategies Index or CSI (Maxwell and Caldwell 2008), which counts the frequency and severity of behaviors in which people engage when they do not have enough food or enough money to buy food. Recent work on the CSI has identified a more "universal" sub-set of coping behaviors found to be relevant in 14 different context-specific CSI instruments (Maxwell, Caldwell, and Langworthy, 2008). This "reduced CSI" (rCSI) is probably more widely used now than the original form, but tends to measure only the less-severe coping behaviors. Versions of the CSI have been widely adopted by WFP/VAM (World Food Programme/Vulnerability Analysis Mapping unit), FAO/FSNAU (UN Food and Agriculture Organization/Food Security and Nutrition Analysis Unit for Somalia), and the Global IPC (Integrated Phase Classification) team, among others. The Household Hunger Scale was designed to capture household behaviors signifying insufficient quality and quantity, as well as anxiety over insecure access. The Household Hunger Score (HHS) was derived from the HFIAS as a culturally-invariant subset of questions, and includes three specific questions, none of which are psychological in nature (Deitchler et al. 2010). USAID, FAO, and others have adopted and promoted the HFIAS and HHS.

Babatunde et al. (2007) is another detailed work on food insecurity in Nigeria. The study utilized a three-stage random sampling technique to obtain a sample of 94 farm households and a cross sectional data in year 2005. Using the recommended calorie required approach; the study revealed that 36 per cent and 64 per cent of the households were food secure and food insecure respectively. The Shortfall/Surplus index showed that the food secure households exceeded the recommended calorie intake by 42 per cent, while the food insecure households fell short of the

recommended calorie intake by 38 per cent. A log it regression model estimated showed that household income, household size, educational status of household head and quantity of food obtained from own production were found to determine the food security status of farming households in the study area.

This objective will try to compare how the most frequently used indicators of food security portray static and dynamic food security among the sampled population of Marsabit County. Seven food security indicators were assessed. These indicators provide very different estimates of the prevalence of food insecurity, but are moderately well correlated and depict generally similar food security trends over time. The differences in prevalence estimates, and in some cases the weaker than expected correlation, can be explained in three ways. First, the indicators differ in the underlying aspect of food security they attempt to capture. Second, each indicator is likely only sensitive within a certain severity range of food insecurity and these ranges do not always overlap. Third, categorization of the prevalence of food insecurity is strongly dependent on the choice of cut-off points. For valid reasons, "food insecurity" has no accepted gold standard metric against which individual indicators can be gauged, though without one it is difficult to say which indicator performs "best" in correctly and reliably identifying food insecure households. The implication is that using more than one indicator is advisable, and policy makers should be aware of what elements of food insecurity each indicator portrays. We shall explore prevalence of food insecurity amongst the sampled population, and the extent to which this food insecurity is a recurrent (seasonal) event versus an episodic event resulting from extreme weather events.

2.2.1 Reduced Coping Strategy Index (rCSI)

The rCSI was developed to assess the household food security situation. Weighted scores are combined into an index that reflects current and perceived future food security status(CARE/WFP, 2003; Maxwell et al, 1999).Several studies have shown that there are set of behavioral responses to food insecurity that can be employed by any household, anywhere and this reflects accurately the food insecurity status of the households. These responses have universal severity weighting that can be applied across different context to establish the reduced coping strategy index, which Maxwell, et al(2008) note reflects the food security situation accurately as the full index. A coping strategy is an action taken (strategy adopted) by

households/individuals when shocks push them beyond the difficulties faced in 'normal' times. The index, is a set of questions about the strategies households adopt to cope with the situation of insufficient food or lack of money to buy food. From this origin, the use and analysis of variations of Coping Strategy Indices have been expanded to measure responses to stress across several domains. An rCSI is composed of indicators designed to assess household practices to mitigate, or respond to, stresses faced. The analysis completes in three steps:

Step 1: Constructing an appropriate list of coping strategies employed by households in the event of food insecurity crisis. It is for application solely within the food security sector, this is done by asking a question 'What do you do when you don't have enough food and don't have enough money to buy food?'

Step 2: Counting the frequency of each coping strategy employed within a given timeframe.

Step 3: Assigning weights to each coping strategy based on the severity of the strategy. This is an inherently subjective process, and benefits from use of standard participatory tools (for example, proportional piling) to generate consensus among a diverse group.

The score for each individual coping strategy is calculated by multiplying the frequency and the severity. The total rCSI score is the sum of all the individual scores included in the rCSI. This constitutes the index value, which can be used for assessing the current situation and measuring the impact of interventions over time.

Table 2.1: Assessing the current situation and measuring the impact of interventions over time

Coping strategies	Universal severity weight
1. Rely on less preferred and less expensive foods	1
2. Borrow food or rely on help from friends or relatives	2
3. Limit portion size at mealtime	1
4. Restrict consumption by adults in order for small children to eat	3
5. Reduce number of meals eaten in a day	1

Source: (WFP,VAM)

Classification (IPC) will use a set of five coping strategies with a universal severity scale 1–3 (see Table above). The rCSI score is classified in three groups to explain the household coping strategies:

- rCSI= 0–3; no or low coping strategies

- rCSI = 4–9: stress coping actions
- rCSI=10-18: crisis coping strategies
- rCSI>18: emergencies coping strategies

2.2.2 Food Consumption Score (FCS)

The food consumption score is used to examine prevalence of food security. It uses data from dietary diversity and household food access over a seven-day recall period. This indicator has been widely used by the World Food Program (WFP, 2008; Jones et al., 2013). The diversity of consumption is analyzed across a given number of food groups, normally eight, with assigned weights. The Food Consumption Score (FCS) is a composite score based on dietary diversity, food frequency, and the relative nutritional importance of different food groups. The FCS is calculated using the frequency of consumption of different food groups consumed by a household during the 7 days before the survey. Scores are clustered into three groups; the results of the analysis categorize each household as having either poor, borderline, or acceptable food consumption. This composite score, measuring food frequency and dietary diversity, can be used in a variety of ways, including to: compare food consumption across geography and time, target households in need of food assistance, monitor seasonal fluctuations in food consumption and provide key diet information to early warning analyses.

In the computation of food consumption score, households are asked to recall the foods they consumed in the previous seven days, each food item is given a score of 0 to 7, depending on the number of days it was consumed. The household score can have a maximum value of 112, which implies that each of the food groups was consumed every day for the last seven days. The household score is compared with pre-established thresholds that indicate the status of the household's food consumption. World Food Programme (WFP) finds the following thresholds to be applicable in a wide range of situations:

- Poor food consumption: 0 to 21
- Borderline food consumption: 21.5 to 35
- Acceptable food consumption: > 35

2.2.3 Household Dietary Diversity Score (HDDS)

The HDDS is a population-level indicator that is used as a proxy measure of household food access (Swindale & Bilinksy, 2006). This indicator is sometimes used as a proxy for the access dimension of food insecurity, and is one of the indicators frequently used to assess how interventions designed to increase household income have affected food consumption (Swindale & Bilinsky, 2006).

The following 12 food groups are used to calculate the HDDS indicator:

Table 2.2: Food groups are used to calculate the HDDS indicator

A.	Cereals
B.	Roots and tubers
C.	Vegetables
D.	Fruits
E.	Meat, poultry, offal
F.	Eggs
G.	Fish and seafood
H.	Pulses, legumes, nuts
I.	Milk and milk products
J.	Oil/fats
K.	Sugar/honey

Each food group is assigned a score of 1 (if consumed) or 0 (if not consumed). The household score will range from 0 to 12 and is equal to the total number of food groups consumed by the household:

HDDS= SUM (A +B + C + D + E +F + G + H + I + J + K)

The average household dietary diversity score for the population of study can be calculated as follows:

HDDS/ Number of households sampled.

2.2.4 Food Insecurity Experience Scale: (FIES)

Food Insecurity Experience Scale (FIES) is experience-based measures of household or individual food security. The FIES measurement consists of eight questions regarding people's access to adequate food, and can be easily integrated into various types of population surveys. The FIES questions refer to the experiences of the individual respondent or of the respondent's household as a whole. The questions focus on self-reported food-related behaviors and experiences associated with increasing difficulties in accessing food due to resource constraints.

During the last 12 months, was there a time when, because of lack of money or other resources:

1. You were worried you would not have enough food to eat?
2. You were unable to eat healthy and nutritious food?
3. You ate only a few kinds of foods?
4. You had to skip a meal?
5. You ate less than you thought you should?
6. Your household ran out of food?
7. You were hungry but did not eat?
8. You went without eating for a whole day?

People experiencing moderate levels of food insecurity will typically eat low quality diets and might have been forced, at times during the year, to also reduce the quantity of food they would normally eat, while those experiencing severe levels would have gone for entire days without eating, due to lack of money or other resources to obtain food.

2.2.5 Household Hunger Scale (HHS).

Household Hunger Scale (HHS) is a simple indicator to measure household hunger in food insecure areas. The HHS is different from other household food insecurity indicators in that it has been specifically developed and validated for cross-cultural use. This means that the HHS produces valid and comparable results across cultures and settings so that the status of different population groups can be described in a meaningful and comparable way—to assess where resources and programmatic interventions are needed and to design, implement, monitor, and evaluate policy and programmatic intervention.

The household hunger score is built around 3 questions about perceptions of a household on varying degrees of hunger by the number of times a household has experienced hunger within past 30 days prior to the survey.

<u>Three questions are:</u>

1. In the past 30 days, was there ever no food of any kind to eat in your house because of lack of resources to get food?

2. In the past 30 days, did you or any household member go to sleep at night hungry because there was not enough food?
3. In the past 30 days did you or any household member go a whole day and night without eating anything at all because there was not enough food?

Three scoring options for scoring the response to each question are:

Never (0 times) =0 score

Rarely/ Sometimes (1-10 times) = 1 score

Often (more than 10 times) =2 scores

HHS = Score of response 1+ Score of response 2 + Score response 3.The total HHS ranges from 0 to maximum 6 score.

The following thresholds of HHS are used to categorize households into three hunger groups – None or light, Moderate and Severe:

0-1 score: None or light hunger

2-3 scores: Moderate hunger

4-6 scores: Severe hunger

2.3 Determinants of food insecurity in households

Literature attributes food insecurity to the declining production levels associated with the inherent difficulties of farming on fragile soils, the growing demand for more food, lack of more arable land, and a labyrinth of political, technical and structural constraints (Omosa, 1996). To counter this, Kenya's government policies have endeavored to adopt strategies that can enhance food security. In spite of these efforts, achieving food security for communities living in Marsabit County has remained an elusive goal. Food security is of prime concern in Bangladesh, despite marked improvements in food production and the incidence of poverty since the country's independence in 1971. The rate of poverty decreased from 48.9 per cent in 2000 to 24.3 per cent in 2016 (The World Bank, 2017) while the population growth rate has decreased from 2.4 in 1970 to 1.47 in 2011 (BBS, 2013). Production of rice, the main staple food, has more than tripled from 16 million tons in 1970 to more than 50 million tons in 2010 (FAO, 2012). This indicates that the country is close to achieving self-sufficiency in food production. Despite these successes, the country belongs to the club of seven countries where two-thirds of the world's 906 million undernourished people live (FAO, 2010).

Vulnerable households are likely to suffer food deprivation. This is because even if their current food consumption is adequate, they will experience a reduction in food consumption or the quality of food consumed should their income fall (Smith and Ali, 2007). Other causes of food insecurity are unfavourable climate, economic shocks, political instability, diseases, poverty and unequal distribution of food within households (Smith and Ali, 2007). Although the most severe food insecurity is often associated with disasters (drought, flood, war, earthquake, etc.) most food insecurity is related to chronic poverty. Thus, survey-based estimates of food insecurity are strongly correlated with poverty estimates (Barrett, 2010). The causes of food insecurity are, however, population-specific, depending on the circumstances affecting the population. A concept related to food insecurity is vulnerability.

The determinants of food security have been investigated for various countries including Ethiopia (Bogale, 2012), Ghana (Owusu et al., 2011), Zimbabwe (Mango et al., 2014), Kenya (Kassie et al., 2014), Brazil (Felker-Kantor and Wood, 2012) and Nigeria (Arene and Anyaeji, 2010). Some studies for Pakistan are (Asghar and Muhammad, 2013, Shaikh, 2007, Sultana and Kiani, 2011), but they are either for whole Pakistan (Gill and Khan, 2010) or for another province i.e. for Punjab (Bashir et al., 2013a) and some studies also utilized secondary data (Asghar and Muhammad, 2013, Sultana and Kiani, 2011). Scholars have argued that food availability at a national level does not necessarily assure food security at the household or individual level, mainly due to lack of economic access to food by the poorer households (Alam, 2016; Harrigan, 2008;Schmidhuber&Tubiello, 2007). Hong Kong and Singapore are food secure, although they are not self-sufficient in food production (agriculture is non-existent). In contrast, India is self-sufficient in food production; however, a large part of its population is not food secure (Reji, 2013; Schmidhuber & Tubiello, 2007). An important consideration for food security is whether the monetary and non-monetary resources at the disposal of the population are sufficient to allow access to adequate quantities of food (Alam, 2016; Barrett, 2010; Schmidhuber & Tubiello,2007). Food insecurity exists largely as a consequence of limited resources problem affecting many households in Bangladesh, and globally. Therefore, a better understanding of household food security dynamics from a resource-poor rural perspective is becoming more crucial in the changing global market economy. In Bangladesh, a growing concern among policymakers is that certain groups within the country do not have access to the quantity of food required for an active and healthy life (GoB, 2016). This food insecurity due to

lack of access to food has negative consequences for people's health, productivity and well-being, which can worsen the poverty situation (Alam, 2016; Chavas, Petrie & Roth,2005; Harrigan, 2008). Stiglitz (1976) argued that the likelihood of obtaining a job and a fair wage rate depends on the job seeker's health condition. Scholars have also pointed out that a lower consumption of calories can be a key risk factor for many chronic diseases of later life (Hamelin, Habicht & Beaudry, 1999; Lim, 2017). Consuming less than the daily calorie requirement increases people's vulnerability to sickness and infectious diseases, which results in missed work, hence missed wages (Lim, 2017; Rice & Dorothy, 1985). Moreover, human development also significantly depends on food security (Hamelin et al., 1999). In Bangladesh, most studies on food security have been conducted at a national level (refer, for instance, Ahmed et al., 2012; Dorosh& Rashid, 2013; Faridi & Wadood, 2010; Hossain, 2010; Rich, Lesley, Kavita, Golam & Setara, 2015; Shahabuddin, 2010; Talukder, 2005; among many), and this remains relatively unexplored in a household context. There is a lack of information on factors influencing household food security, especially for the most vulnerable population of Bangladesh.

Sub-Saharan Africa is facing a huge challenge of feeding the ever increasing population. About 90% of the rural population depends on agriculture for their livelihoods, still they are suffering from the problem of food insecurity, and this is mainly due to low productivity and belligerent agro-ecological factors. World food summits and international development has only one agenda; reduction of hunger and food insecurity (Rukuni, 2002), but still some household remain deficient in food resources. South African governments pledged to half poverty rate from 2004 to 2014. It is hard to manage this goal with household food security. Hence, in 2002, the government adopted Integrated Food Security Strategy (IFSS). The vision of this strategy is: "to attain universal physical, social and economic access to sufficient, safe and nutritious food by all South Africans at all times to meet their dietary and food preferences for an active and healthy life" (IFSS, 2002). According to IFSS, South Africa is confronted with various key challenges regarding food security. Nevertheless, South Africa still is lacking precise and recognized ways to measure food insecurity and presently has no controlled method of monitoring the status of food security. (De Cock et al., 2013) examined the food security situation in Limpopo Province. Both qualitative and quantitative data were utilized for the purpose of analysis. The study found that 53% of the rural households were food insecure. Important determinants were human capital

(education), household size, dependency ratio, household income and the area in which the study was undertaken.(Bogale, 2012) examined the factors which determine the household level of susceptibility to food insecurity by utilizing method of expected poverty approach having data obtained from 277 randomly selected households in Ethiopia.

Besides natural disasters that can alter the food security status of households and usually make them vulnerable to food insecurity, socio-economic characteristics of households can also influence the food security status of households (John et al (2013). They further argue that since human beings have less control over natural occurrences, focusing on socio economic characteristics of households will provide better alternative in addressing food security challenges. However, Khatri-Chetri and Maharjan (2006) maintain that a high level of exposure to risk of natural disasters and lack of ability or means to cope with them affect to a very great extent the food security status of households. These are indications that both factors (risks and households' socio-economic characteristics) are important determinants of vulnerability to food insecurity. The food insecurity of household is associated with many factors including the size of the family, cultivated land size, the fertility of soil, irrigation access, number of extension visits, fertilizer use and improved seed. The cut-off level has been computed and household whose expenditure falls below the specified level was identified as vulnerable.

The total number of food insecure household was lower (103) than vulnerable household (111). According to (Owusu et al., 2011) non-farm work affect household food security in Ghana and the result of the study supported the widely accepted view about non-farm income; that it adds to eradication of poverty, while (Mango et al., 2014) investigated factors affecting household food security in district Mudzi of Zimbabwe by using data obtained from 120 randomly selected households through a structured questionnaire. Age of the household head, education of household head, household labor size, and ownership of livestock, remittances and access to market information were found to be positively influencing household food security. It appears that other than climatic conditions, there are other factors that determine the degree to which households are exposed to seasonal fluctuations in food availability. This study attempts to appreciate food insecurity situation in Marsabit County and to isolate the factors that are more critical in explaining food insecurity. Myriad of issues can be associated to the factors that causes food insecurity in Marsabit County, however, limited research has been undertaken which

doesn't directly link food insecurity to those factors and therefore this research will zero in to the key determinants of food insecurity. Results from the study are expected to provide useful information to aid policy formulation and intervention geared towards addressing determinants of food insecurity in Marsabit County.

2.4 Conceptual Framework

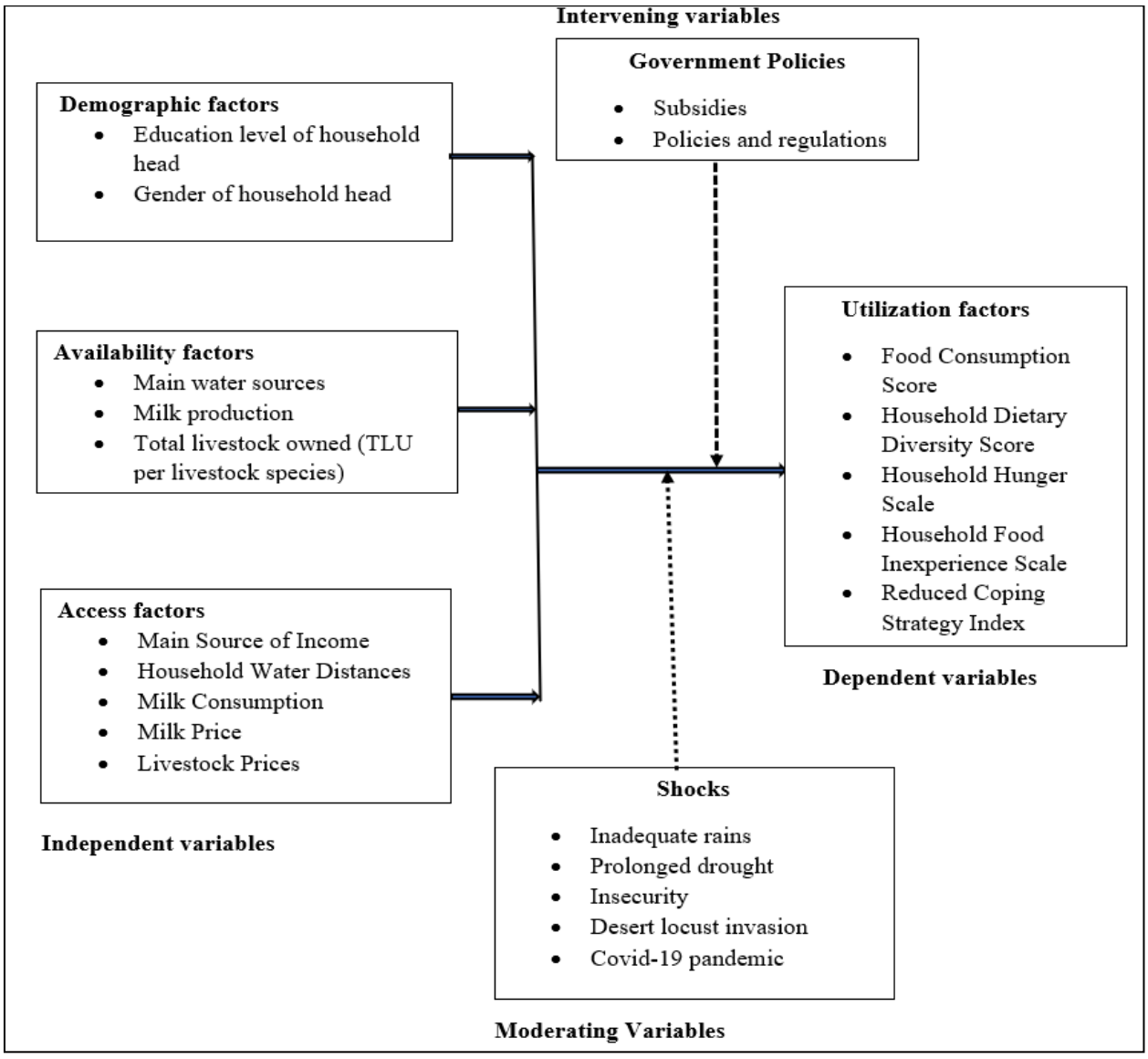

Figure 2.1: Conceptual Framework

In the conceptual framework, the independent variables are demographic actors and food insecurity indicators of availability and access. The demographic characteristics are education level of household head and gender of household head. The food availability factors are main

water sources utilized by the households, daily average milk production at the household level and total livestock units for each of the livestock species while food security access indicators are main sources of income, household water distances, milk consumption, prices of milk and livestock prices for each of the species (cattle, camel, goats and sheep).

The dependent variables used in the study are main food insecurity utilization indicators of food consumption score that measures dietary diversity and meal frequency in a recall period of seven days, reduced coping strategies index that measures consumption based coping mechanism that households adopt in a recall period of seven days, household dietary diversity score that measures food access, household hunger score that measures cross-cultural level of household hunger in food insecure areas and food insecurity experience scale is an experience-based measurement of household food insecurity.

Therefore, independent variables of demographic actors and food insecurity indicators of availability and access were used to investigate the determinants, trends and prevalence on food insecurity indicators (dependent variables) on food utilization factors. Shocks such as inadequate rains, prolonged drought, insecurity, desert locust invasion and Covid-19 pandemic were classified as moderating variables since they affected the magnitude of the effect of demographic factors and food insecurity factors of availability and access on food insecurity utilization indicators of FCS, HHS, HDDS, CSI and FIES in Marsabit County. In periods of shocks, the National Government always provide subsidies and regulations to cushion households during the food insecure periods.

Having reviewed related literature and explained conceptual framework in Chapter two, the study proceeded to Chapter 3, which describes the study area, research design used in the study, the study population, sample size and sampling techniques used. Sources of data, data collection methods and analysis techniques were also explained. The research methodology in Chapter 3 aimed at generating the most reliable, valid and authentic results from the data collected so as to address the study gaps under each specific objective as identified in the cited literature**.**

CHAPTER THREE
METHODOLOGY

3.1 Research Design

The study adopted cross sectional descriptive research design where data was gathered at the household level. The study examined determinants of trend and contributing factors on household food security in Marsabit County. A two-stage sampling technique was adopted. Stage one involved purposive random sampling of the wards and then afterwards households were subjected to simple random sampling from the presampled 11 wards (Golbo, Dukana, Heillu Manyatta, Uran, Turbi/Bubisa, Laisamis, Sagante, Korr/Ngurunit, Loiyangalani, Karare and North Horr) which have experienced multi shocks for the last 5 years. The analysis provided evidence necessary to effectively design, deliver and monitor community food security trends that often supports sectoral food security emergency response mechanisms for the area. Research approaches (logistic regression and ARIMA models) on food insecurity were tested to provide evidence that supports policy within the rural communities often prone to food insecurity during extreme shocks such as rainfall failure, prolonged drought, desert locust invasion, insecurity and Covid-19 pandemic.

3.2 Study Area

Marsabit County falls within arid and semi-arid area, and as such can be classified as a dryland county. The County, with a total area of 70,961.2 sq. km is located in the extreme end of northern Kenya and it lies between latitude 02^{o} 45^{o} North and 04^{o} 27^{o} North and longitude 37^{o} 57^{o} East and 39^{o} 21^{o} East. Marsabit County lies in four main ecological zones, namely, sub-humid, semi-arid (mainly woodlands), arid (predominantly bush land) and very arid (scrublands) and Sub-Humid/Forest Zones - Ecological Zone II**.** The county has arid climatic condition with the exception of the areas around Mt. Marsabit, Mt. Kulal, Hurri Hills and the Moyale-Sololo escarpment which represent typical semi-arid condition. It has a bi-modal rainfall pattern. The long rainfall season is between April and May while the short rainfall season is between November and December. Rainfall ranges between 200mm and 1,000mm per annum and its duration, amount and reliability increases with rise in altitude. North Horr (550m) has a mean annual rainfall of 150mm; Mt. Marsabit and Mt. Kulal experience 800mm while Moyale receives a mean annual rainfall of 700mm.

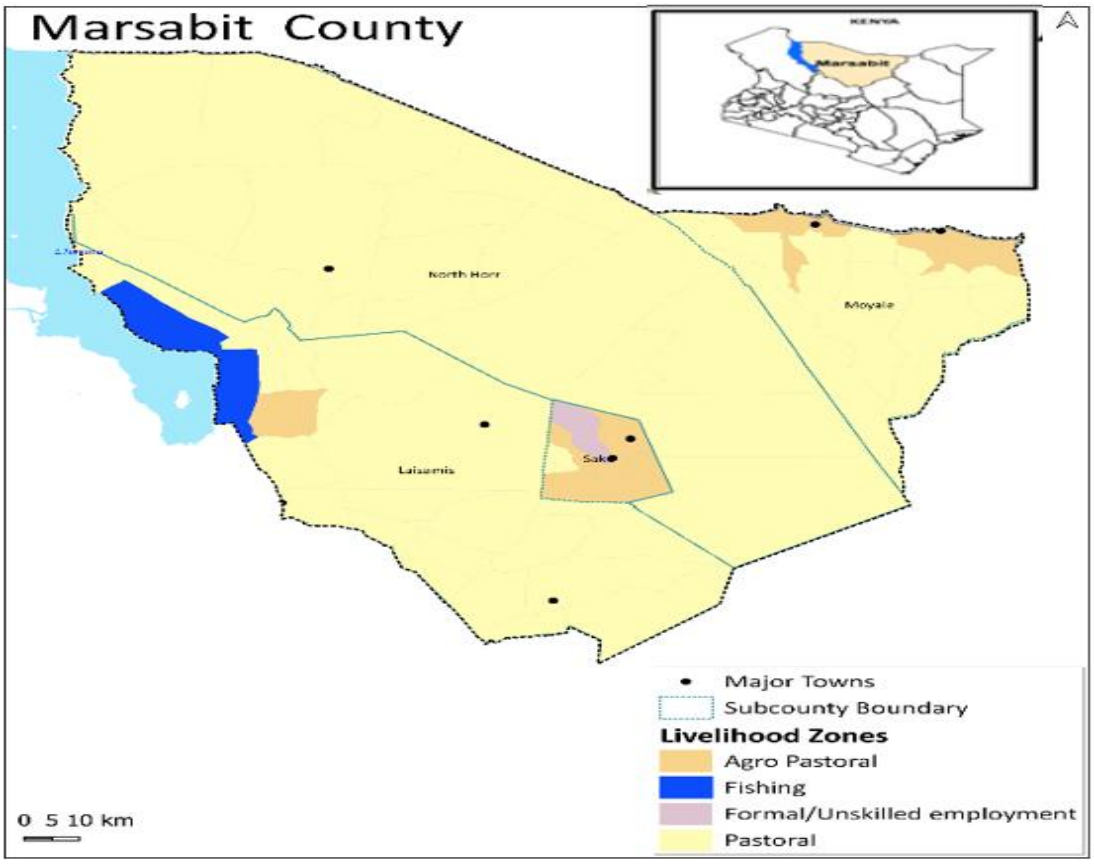

Figure 3.1: Marsabit County Map

Source: KFSSG, 2022

Administratively, Marsabit County is divided into four sub-counties (also referred to as constituencies), namely; Saku, Laisamis, North Horr and Moyale.

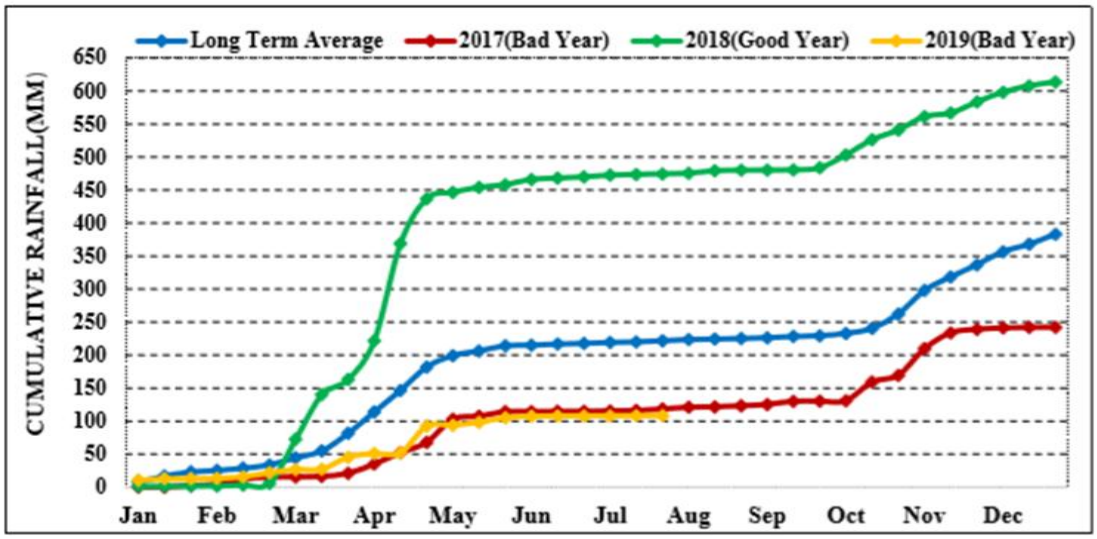

Figure 3.2: Marsabit County Rainfall Cumulative Amounts (mm)

3.3 Population of the Study

According to the 2019 Population and Housing Census, Marsabit County has a total population of 459,785 people that comprised of 243,548 male and 216,219 female with total households being 77,495. The target population comprised of 24,004households that were within the presampled six wards. A household questionnaire was administered to each of the 399 households, which were clustered into administrative wards of Uran (3392); Golbo (5513); Loiyangalani (4389); Laisamis (4446); North Horr(3827) and Karare (2437) as shown in Table 3.1.

3.4 Sample size

Determination of the sample size was based on the formula given by Kothari (2004) as shown below:

$$n = \frac{z^2 p(1-p)}{e^2}$$

$$n' = \frac{n}{1 + \frac{z^2 \times \hat{p}(1-\hat{p})}{\varepsilon^2 N}}$$

Where;

n is the sample size

N is total number of households from the 6 presampled wards=24,004 households

z is the z-score value corresponding to 5% level of significance

Ɛ is the margin of error= 0.05

$p = 0.5$

Therefore, n= 399

Statistically a proportion of 0.5 results in a sufficient and reliable size particularly when the population proportion is not known with certainty. This led to q of 0.5 (1- 0.5). An error of less than 10% is usually acceptable according to (Kothari, 2004). Thus, an error of 0.05 was used to approximate a sample size of 399households. The 399 households were distributed across the major wards proportionate to the population as shown in (Table 3.1) below.

Table 3.1: Sample Size Distribution

Wards	Total Number of Households	Sample Size (Households)
Uran	3392	56
Golbo	5513	91
Loiyangalani	4389	73
Laisamis	4446	74
North Horr	3827	64
Karare	2437	41
Total	**24004**	**399**

Source: The researcher, 2021

3.5 Sampling Procedure

The population of the study (399 households) consisted from the major administrative boundaries in Marsabit County. Purposive sampling was adopted to select six wards from a total of 20 wards with an interest of those wards which have experienced multiple layers of shocks for the last 5 years in Marsabit County which included; (Golbo, Uran, Karare, North Horr, Laisamis and Loiyangalani wards).From the selected wards, simple random sampling was used to select 399 households proportionate to the total number of households. To ensure randomness in the sampling, computer generated random number table was applied to the list to select the households surveyed in the study. Secondary food insecurity indicators data from NDMA mainly on food consumption score (FCS), reduced coping strategies index (CSI), household hunger scale (HHS), food insecurity experience scale (FIES) and household dietary diversity score from the years 2017-2020 was used for triangulation with the collected primary data. A total of 322 households were successfully interviewed across the presampled wards from a target sample size 399 households which represented 81% response rate as shown in (Table 3.2) below.

Table 3.2: Successfully Administered Questionnaires

Ward	Sample Size	Households that responded	Response Rate
Uran	56	46	82%
Golbo	92	74	80%
Loiyangalani	73	59	81%
Laisamis	74	60	81%
North Horr	64	51	80%
Karare	41	33	80%
Total	**399**	**322**	**81%**

Source: Researcher, 2021

3.6 Sources of Data

Data was obtained from primary sources using a structured household questionnaire and triangulated with secondary data sources from NDMA.

3.6.1 Data Sources

Data was gathered from primary data during the study and beefed up with secondary data. The secondary data included data sets from NDMA on food consumption score (FCS), reduced coping strategies index (CSI), household hunger scale (HHS), food insecurity experience scale (FIES) and household dietary diversity score from the years 2017-2020. Primary data was mainly obtained using structured questionnaires save for a few questions on continuous response where semi-structured collection was employed.

3.6.2 Data Collection Procedure

Questionnaires, interview schedule and document analysis guide were used to collect data in such a way that they generated as much information as possible in line with the study objectives.

3.6.3 Instruments for Data Collection

Questionnaires

The researcher majorly used close ended type of questions during the study. This instrument made it possible to reach a required number of respondents (322 households) who were able to give feedback during the questionnaires administration. Closed ended questions were used for the purpose of getting specific information by providing the respondents with all possible alternatives from which the respondents select the answer that best describes their situation. The advantage of using questionnaire is that it was administered by the researcher to respondents in their own private settings hence confidentiality maintained. The household questionnaire collected data on education level of household head, gender of household head, main water sources utilized by the households, daily average milk production at the household level, total livestock units for each of the livestock species, main sources of income, household water distances, milk consumption, prices of milk , livestock prices for each of the species (cattle, camel, goats and sheep), food consumption score, coping strategies index, household dietary diversity, household hunger score and food insecurity experience scale. Data obtained which was mainly quantitative was used to explain trends, determinants and prevalence of household food insecurity in Marsabit County.

3.6.4 Reliability Tests for Data Collection

Data collected was tested for relevance and consistency of results in order to minimize errors. The reliability of the instrument was done by conducting a pre-test survey to test responses that were consistent across board and that the administration of the questionnaire and scoring done with great precision. Reliability test was ascertained through Cronbach's Alpha determination at a coefficient of 0.7 and above considered as acceptable by George Mallery (2003). Therefore, the questionnaire was accepted as reliable.

3.6.5 Validity Tests for Data Collection Instrument

Validity means the extent to which the concept one wishes to measure is actually being measured by a particular scale or index (Creswell, 2003).To measure validity of instruments used in this study, content validity was tested. Mugenda and Mugenda (2003) define content validity as the measure of the degree to which data collected using a particular instrument represents a specific domain of indicators or content of a particular concept, that is, an instrument should provide adequate coverage of a topic. Expert opinions and pre-testing of instruments helps to establish content validity (Wilkinson, 1991; Mugenda and Mugenda, 2003). These instruments for data collection were also pre-tested during the pilot survey.Data collection instrument yielded data that enabled one to draw meaningful inferences from the scores. It was able to measure intended content and the scores predicted a criterion measure and whether the scores obtained were practical.

3.7 Data Analysis and Results Presentations

Data analysis involved ordering of data into consistent parts in order to obtain answers to research questions (Ahuja, 2003). This research adopted quantitative data analysis methods of descriptive statistics, time series plots, autocorrelation and partial autocorrelation tests, Box Jenkins ARIMA test and ordinal logistics regression test. Descriptive analysis was conducted on demographic characteristics and food insecurity indicators to examine mean of each variable, standard deviation, minimum and maximum values. Since the food insecurity indicators such as Coping Strategies Index (Minimal, Stressed, Crisis), Food Consumption Score (Poor, Borderline and Acceptable), Household Hunger Scale (No hunger, moderate hunger and severe hunger), Household Dietary Diversity Score and Food Insecurity Experience Scale are of the three levels and are ordered, ordinal logistic regression analysis was used to examine the determinants of

household food insecurity. Quantitative data analysis involved the idea of using themes and categories that served to pull together and give meaning to a series of otherwise discrete events, statements and observation in the data (Charmaz, 1983). Results were presented in graphical form (trends of food insecurity indicators of Coping Strategies Index (rCSI), Household Hunger Scale (HHS), Food Consumption Score (FCS), Household Dietary Diversity Scale (HDDS) and Food Insecurity Experience Scale (FIES) against time in months from January 2017-December 2020) and in form of tables (description of variables used in the study, descriptive statistics of the data collected by food insecurity indicators, prevalence and determinants of food insecurity indicators).

Objective 1: To assess temporal variation of food insecurity in the period 2017-2020 in Marsabit County, Kenya.

Time series plot of food insecurity indicators of Coping Strategies Index (rCSI), Household Hunger Scale (HHS), Food Consumption Score (FCS), Household Dietary Diversity Scale (HDDS) and Food Insecurity Experience Scale (FIES) against time in months from January 2017-December 2020 were plotted to examine trends over time. Partial and autocorrelation tests were done to determine the lag and difference values of the ARIMA model.

A time series Y_t (t=1,2...) is said to be stationary (in the weak sense) if its statistical properties do not vary with time (expectation, variance, autocorrelation). The white noise is an example of a stationary time series, with for example the case where Y_t follows a normal distribution N(mu, sigma^2) independent of t.

Identifying that a series is not stationary allows to afterwards study where the non-stationarity comes from. A non-stationary series can, for example, be stationary in difference (also called integrated of order 1): Y_tis not stationary, but the Y_t - Y_{t-1} difference is stationary. It is the case of the random walk. A series can also be stationary in trend. Stationarity tests allow verifying whether a series is stationary or not. There are two different approaches: stationarity tests such as the KPSS test that consider as null hypothesis H0 that the series is stationary, and unit root tests, such as the Dickey-Fuller test and its augmented version, the augmented Dickey-Fuller test (ADF) for which the null hypothesis is on the contrary that the series possesses a unit root and hence is not stationary.

Box - Jenkins Analysis refers to a systematic method of identifying, fitting, checking, and using integrated autoregressive, moving average (ARIMA) time series models. The method will be appropriate for time series of medium to long length. The series may be denoted by X1, X2, Xt,,,,,, where t refers to the time period and X refers to the value. If the X's are exactly determined by a mathematical formula, the series is said to be deterministic. If future values can be described only by their probability distribution, the series is said to be a statistical or stochastic process.

The ARMA (autoregressive, moving average) model is defined as follows:

Xt = φ 1 Xt−1 + ,,,,, + φ p Xt− p + at −θ 1at−1 − ,,,,,, −θ qat−q where the φ's(phis) are the autoregressive parameters to be estimated, the θ's (thetas) are the moving average parameters to be estimated, the X's are the original series, and the a's are a series of unknown random errors (or residuals) which are assumed to follow the normal probability distribution. Box-Jenkins use the backshift operator to make writing these models easier. The backshift operator, B, has the effect of changing time period t to time period t-1. Thus BXt = Xt−1 and B XtXt 2 = −2. Using this backshift notation, the above model may be rewritten as: (1− φ 1B − − φ B) X = (1−θ 1B − −θ B)a p p t q qΛΛ t This may be abbreviated even further by writing: φ p (B)Xt θ q (B) t = a where φ p ( ) (φ φ p) p B = 1− 1B − ,,,,,, − B and θ q ( ) (θ θ q) q B = 1− 1B − ,,,, − B

Objective 2: To estimate the prevalence of food insecurity y in Marsabit County, Kenya.

Proportion computation was subjected to the food security outcomes of Reduced Coping Strategies Index (rCSI); Household Hunger Scale (HHS); Food Consumption Score (FCS); the Household Dietary Diversity Scale (HDDS) and Food Insecurity Experience Scale (FIES) estimate the prevalence. The proportions were computed per each category of the food security outcomes at household level. For example: Food Consumption Score is categorized into poor, borderline and acceptable bands.

Objective 3: To identify the key causes/determinants of household food insecurity in Marsabit County

fi= j β j Xij +εi

Where fi= Household food security

where X_{ij} are termed as explanatory variables and e_i is the error term, which is assumed to be uncorrelated with the explanatory variables. The observed variable is food security, where $Z_i = 1$ when $f_i^* \geq 0$ and $Z_i = 0$ when $f_i^* < 0$ for i^{th} household. Since the observed dependent variable Z_i is binary/discrete in nature, the food security model can be framed as a response model (logit or probit) of qualitative variables, where $Ø_i$ is the probability of food security specified as:

$$Øi=\text{Prob}(Z_i = =1)\text{Prob}\left(\sum_{j=1}^{n=k} \beta_j \quad ij \quad \varepsilon_i > \right)_{X+0} \qquad \textbf{(2)}$$

Now, the logistic regression can be applied to this model because it directly estimates the probability of an event occurring for more than one independent variable, that is, for *k* independent variables (Demaris, 1992; Feleke et al., 2005; Hailu & Nigatu, 2007). The logistic regression model of food security was written as:

$$Ln\left(\frac{1-ØØ^{i\,i}}{}\right) = \beta_0 + \sum_{j=1}^{n=k} \beta_j X_i + \varepsilon \qquad j \qquad i \quad \textbf{(3)}$$

where $Ø_i$ is the conditional probability of food security, b_js are parameters to be estimated, and X_{ij}s are the explanatory variables.

3.8 Document Analysis

Documents objectively written about food insecurity in globally, nationally and locally reviewed and analyzed. Secondary data was obtained through review of relevant information from NDMA, journals, websites and books This instrument was used to gather information about the resources and document best practices on causes, prevalence and trends of food insecurity in Marsabit County. Additionally, documentary review helped in the identification of knowledge gaps and supplemented data collected through the questionnaires.

3.9 Research Ethics

In this study before embarking on field work, it was essential to obtain prior permission to conduct interviews and administer questionnaires from the targeted households. The researcher conducted the study in a manner that upheld research ethics. Information provided by the respondents was used for academic purpose only. The research process was free, fair and open, not insulting the private, religious, cultural and social life of the respondents. The respondents were at liberty to freely ignore any questions or concerns they did not wish to respond to. The researcher assisted the respondents in understanding the questions so that information collected was relevant.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.1 Introduction

This chapter presented the empirical evidences on assessment of trends and determinants of household food insecurity in Marsabit County between 2017-2020 (drought and non-drought years) based on the key strategic objectives of to assess temporal variation of food insecurity in the period 2017-2020 in Marsabit County, to estimate the prevalence of food insecurity in Marsabit County and to identify the key causes of household food insecurity in Marsabit County. This chapter described the variables used in the study, descriptive statistics of the variables (categorical and continuous) applied in the study, time series trends of food insecurity indicators (household dietary diversity, household hunger scale, food consumption score, coping strategy index and food insecurity access scale. Cronbach's alpha reliability test was used to examine the internal consistency of research instruments used in the study where coefficient of 0.85 was attained thus reliable.

Prevalence of the food insecurity indicators analyzed in their categories and causes of food insecurity determined through the Ordinal Logistic Regression between outcome variables (FCS, HDDS, CSI, FIAS, HHS) and control variables (main source of income, household water distances, main water sources, milk production, milk consumption, milk price, total livestock owned, livestock prices and education level of household head). The results of Objectives 1 and 3 presented in tabular form while Objective 2 presented in both graphical and tabular forms. Valid interpretations done for each of the objectives based on the food insecurity analysis.

4.2 Description of variables used in the study

Table 4.1: Description of variables used in Data Analysis

Variable label	Variable scale	Variable values
Questionnaire ID	Interval	241594-245168
Educational level of Household Head	Categorical	1=Primary, 2=Secondary 3=Technical Training, 4=University, 5=None
Gender of Household Head	Categorical	1=Male, 2=Female
Main source of income	Categorical	1= Employment, 2=Sale of livestock/livestock products 3=Sale of crops, 4=Casual labour, 5=Trade
Main source of water	Categorical	1=Boreholes, 2=Natural ponds 3=Pans, 4=Piped water, 5=Seasonal rivers 6=Shallow wells, 7=Traditional river wells
Price of milk/litre	Ratio	60-75
Milk production per household per litre per day	Ratio	0-6
Milk consumption per household per litre per day	Ratio	0-3.5
Price of cattle(Kshs.)	Ratio	14581-31300
Price of goat(Kshs.)	Ratio	3009-5496
Price of camel(Kshs.)	Ratio	45064-74967
Tropical livestock unit of cattle	Dummy	0=Lowest, 17.5=Highest
Tropical livestock unit of camel	Dummy	0=Lowest, 15=Highest
Tropical livestock unit of goat	Dummy	0=Lowest, 7=Highest
Tropical livestock unit of sheep	Dummy	0=Lowest, 5=Highest
Food Consumption Score	Categorical	Poor= 0-21, Borderline=21.5-35, Acceptable=>35.5
Reduced Coping Strategy Index	Categorical	Minimal=0-3, Stress=4-18, Crisis=>18
Household Hunger Score	Categorical	None= 0-1, Moderate Hunger= 2-3, Severe Hunger=4-6
Household Dietary Diversity Score	Categorical	0 – 12
Food Insecurity Experience Scale	Categorical	0-1

The table shown above illustrated description of variables that were used during the study. Independent indicators such as highest level of education for household head, gender of household head, main sources of income and water sources are categorical variables while

household water distances, milk prices, milk production, milk consumption, cattle prices, goat prices and camel prices are ration variables. Tropical livestock units for cattle, camel, sheep and goats are dummy variables generated as latent variables multiplied by respective weights. Camel had a TLU of 1, Cattle has a TLU of 0.7 while goats and sheep posted a weight of 0.1. Food insecurity indicators such as food consumption score, household dietary diversity score, coping strategy index, food insecurity experience scale and household hunger score were ordered categorical variables.

4.3 Descriptive statistics for variables in the study

Table 4.2: Descriptive statistics for continuous variables used in the study

Variable name	N	Mean	Standard deviation	Min	Max
Distance from water source (km)	322	2.69	3.16	0	16
Price of milk/litre	322	67.70	4.76	60	75
Milk production/household/litre/day	322	3.08	2.03	0	6
Milk consumption/household/litre/day	322	1.98	1.42	0	4
Price of Cattle (Kshs.)	322	22805.45	4931.49	14581	31300
Price of Goat (Kshs.)	322	4225.44	720.00	3009	5496
Price of Camel (Kshs.)	322	60832.79	9005.50	45064	74967
Tropical livestock unit of Cattle	322	8.99	5.04	0	17.5
Tropical livestock unit of Camel	322	7.23	4.62	0	15
Tropical livestock unit of Goat	322	3.65	2.08	0	7
Tropical livestock unit of Sheep	322	2.54	1.52	0	5

min=Minimum; max=Maximum

The table shown above indicated measures of central tendency of continuous variables used in the study. The total number of households sampled were 322 representing the key livelihood zones. It was deduced that the average household water distance is 2.69Km with the maximum distance being 16Km. The price of milk per litre was Kshs. 68 and ranged between Kshs.60 – Kshs. 75 while household milk production and consumption per litre per day were 3 litres and 2 litres respectively. The average cattle price was Kshs. 22,805 with the highest price being Kshs. 31, 300 whereas camel and goats' prices were Kshs. 60, 833and Kshs. 4,225 respectively. The average tropical livestock units for cattle, camel, goats and sheep were 8.99, 7.23, 3.65 and 2.54 respectively.

Table 4.3: Descriptive statistics for categorical variables used in the study

Food Consumption Score	**n**	**Poor**	**Borderline**	**Acceptable**
	322	7 (0.87)	145 (45.17)	170 (52.96)
Coping Strategy Index		**Minimal**	**Stress**	**Crisis**
	322	34 (10.28)	191(59.50)	97(30.22)
Household Hunger Score		**No Hunger**	**Moderate Hunger**	**Severe Hunger**
	322	45 (13.71)	148(46.11)	129(40.19)
Household Dietary Diversity Score		**Low Dietary Diversity**	**Moderate Dietary Diversity**	**High Dietary Diversity**
	322	3(0.62)	100(31.15)	219(68.22)
Household Food Insecurity Experience Scale		**Food Security**	**Moderate Food Insecurity**	**Severe Food Insecurity**
	322	123(38.32)	191(59.50)	7(2.18)
Gender of Household Head		**1=Male**	**2=Female**	
	322	273(85.05)	48(14.95)	
Educational level of Household Head		**1=Primary**	**2=Secondary**	**3=Technical Training**
		4=University	**5=None**	
	322	38(11.53)	16(4.98)	1(0.130)
		3(0.93)	264(82.24)	
Main source of income		**1=Employment**	**2=Sale of livestock**	**3=Sale of crops**
		4=Casual labour	**5=Trade**	
	322	14 (4.05)	165 (51.40)	1 (0.31)
		73(22.74)	69(21.50)	
Main source of water		**1=Boreholes**	**2=Natural Ponds**	**3=Water Pans**
		4=Piped Water	**5=Seasonal Rivers**	**6=Shallow Wells**
	322	43 (13.08)	19 (5.92)	144 (44.86)
		36 (11.21)	30 (9.35)	23 (7.17)

Percentages in parenthesis ()

The table shown above exhibits percentages for the indicators used in the study that were categorical. It was deduced that the main source for household water consumption is water pan as illustrated with a response rate of 45%. Other sources of domestic water consumption are boreholes, piped water, seasonal rivers, shallow wells and natural ponds at 13%, 11%, 9%, 7% and 6% respectively. The main sources of income are sale of livestock and casual labour at 51% and 22%. Other income sources are employment, trade and sale of crops. It was deduced that majority of the household heads have not gone to school as depicted by 82% response rate. A paltry 12% and 5% of the household heads had attained primary and secondary level of education respectively. Majority of households are male headed as illustrated by 85% response while only 15% of the households were female headed. Majority of the households had

acceptable food consumption score (53%), stressed coping strategies index (60%), moderate hunger (46%), high dietary diversity (68%) and moderate food insecurity (60%).

Table 4.4: Temporal variation of food insecurity in the period 2017-2020 in Marsabit County. Time Series plots of Food Consumption Score and Coping Strategy Index over time (January 2017-December 2020)

Months	Years	FCS (Long Term Average=39.57760) FCS Values	CSI(Long Term Average=18.27096) CSI Values
1	2017	23.91667	34.05
2	2017	18.09076	24.207
3	2017	21.58663	20.1368
4	2017	27.51835	20.1835
5	2017	31.04985	19.7764
6	2017	25.16245	20.7834
7	2017	37.26936	17.9000
8	2017	39.5777	19.3986
9	2017	38.49091	19.4485
10	2017	36.78378	20.1926
11	2017	44.77258	17.7157
12	2017	46.13423	16.9027
13	2018	40.70101	18.2703
14	2018	39.42273	18.2303
15	2018	40.10762	18.6126
16	2018	44.55727	16.5201
17	2018	43.25298	18.4673
18	2018	44.33886	17.1747
19	2018	44.07774	19.5518
20	2018	42.70808	18.3952
21	2018	44.82067	20.4225
22	2018	43.55047	20.6341
23	2018	43.99513	20.211
24	2018	42.94019	18.9174
25	2019	42.17125	18.0000
26	2019	39.47643	17.8081
27	2019	38.90972	19.2896
28	2019	40.22931	19.1943
29	2019	37.58874	19.4489
30	2019	35.85826	18.5105
31	2019	37.26759	18.0939
32	2019	37.17152	18.7599

33	2019	37.53114	18.5274
34	2019	37.66454	18.4019
35	2019	42.88133	15.9321
36	2019	44.95777	16.1824
37	2020	43.20399	15.0399
38	2020	43.63134	13.9701
39	2020	45.21084	14.506
40	2020	40.64748	13.9281
41	2020	41.17391	15.2888
42	2020	47.04332	15.7184
43	2020	42.08249	15.6296
44	2020	47.70184	16.3058
45	2020	47.35449	15.5913
46	2020	42.12857	15.7968
47	2020	43.97022	15.8433
48	2020	39.04266	15.1365

The table above showed the food consumption score and coping strategy index values from January 2017 to December 2020 with their respective long term averages. The FCS and CSI values were secondary data from NDMA which was used to come up with the FCS and CSI line trends shown below.

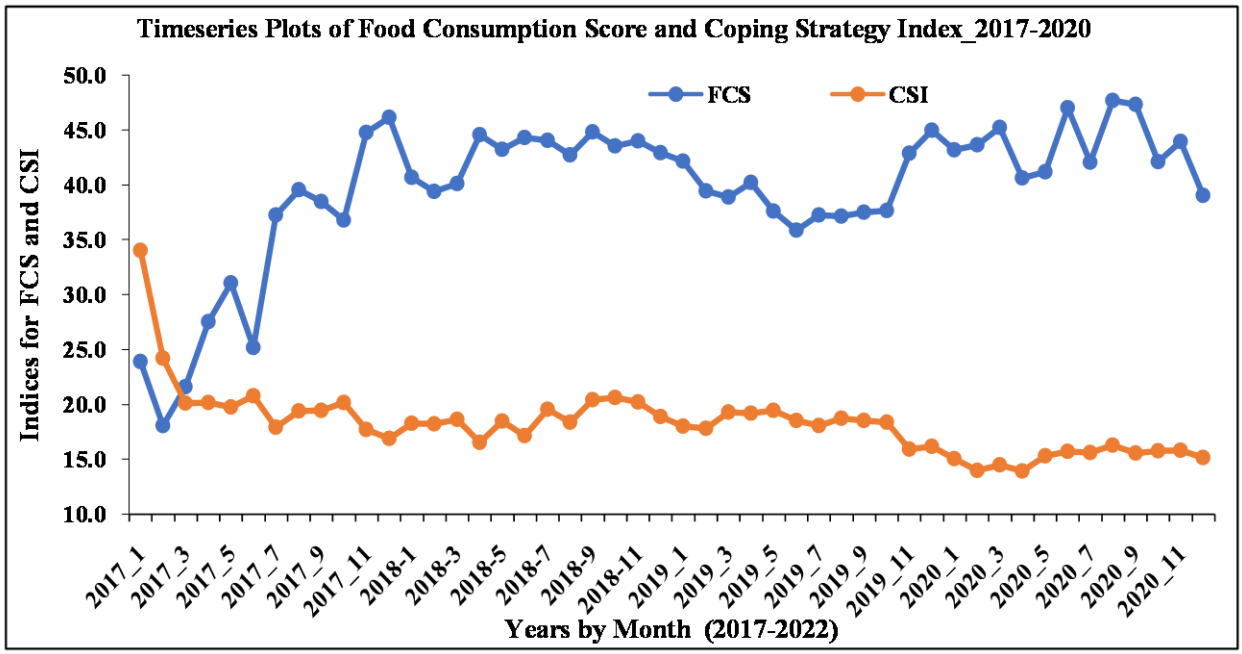

Figure 4.1: Time Series Plots of Food Consumption Score (FCS) and Coping Strategy Index

Figure 4.1 above exhibited time series plots for food insecurity indicators; Food Consumption Score and Coping Strategy Index from January 2017-December 2020 (48 months). Notably, food consumption score posted fluctuations over a period of time. For food consumption score, the higher the score the more food secure households are. A drastic decline in the food consumption score was noted in February 2017 because of the severe drought which was occasioned by two consecutive failure of rainy seasons that led to less frequent food consumption at household level. This confirms to the Short Rains Food Security Assessment of 2017 which indicated that food consumption score significantly deteriorated as 34 percent of the households had poor consumption score, 51 percent border line and 14.5 acceptable. Additionally, food consumption score of 18.09 was considerably below the long term average of 39.58 thus food consumption pattern was poor at household level. However, there were a myriad of food interventions (relief food distributed by National Government, County Government, UN Agencies and NGOs) that gradually improved the food consumption score in the months of March, April and May 2017.

In the year 2018, food consumption score improved and was above the long term average of 39.58 as it was a year characterized by exceedingly above normal rains that led to high crop yields and good livestock productivity hence majority of the households consumed more food groups without external assistance from the government and other partners. Spikes were witnessed in the year 2020 which was an indicative of the effects of COVID-19 containment measures and desert locust invasion that negatively affected food consumption at the household level but still fell above the long term average. Coping strategy index was at an-time high on January 2017 at 34.04 which is significantly above the long-term average. The coping strategy index of 34.04 implied that households adopted emergency coping mechanisms such as restriction of adult consumption for children during the severe drought period which is in tandem with the short rains assessment conducted in2017. For coping strategy index, the higher the index the more food insecure households are. The coping strategy index trend line illustrated gradually declined which was an indicative of households adopting almost similar coping strategies to survive when they lacked food or money to buy food. Common coping strategies that households applied were reliance on inferior food, purchase of food on credit and borrowing of food from either friends or relatives. In the period 2020, coping strategies index posted a stable trend which

implied that there was no change in the coping strategies as households adopted mechanisms to survive with less frequency and severe means to cope.

Table 4.5: Time Series plots of Household Hunger Score and Food Insecurity Experience Scale over time (January 2017-December 2020)

	HHS (Long Term Average=3.06048)	FIES (Long Term Average=4.06425)
Months	**HHS Values**	**FIES Values**
1	3.96667	4.68333
2	3.89172	4.81847
3	3.95137	4.00608
4	3.03364	4.91743
5	3.07251	3.96677
6	3.03610	3.95668
7	2.98387	3.92581
8	2.93581	3.89527
9	3.00606	4.10303
10	2.9223	4.09122
11	3.04013	4.05351
12	2.97315	4.01678
13	3.11149	4.03378
14	2.95455	4.01212
15	3.00331	3.96358
16	3.17647	4.05573
17	2.84821	4.09524
18	3.00000	4.02410
19	2.97561	4.00610
20	2.99401	4.02695
21	3.00608	4.11246
22	2.95584	3.92114
23	2.89610	4.0974
24	3.01223	4.13761
25	3.00306	3.9419
26	3.00310	3.8452
27	3.03354	4.20427
28	2.89429	3.98286
29	2.93189	3.96285
30	3.13814	3.94294
31	3.01818	3.9303
32	2.89362	4.03951
33	2.95548	4.03082
34	3.05919	4.09034

35	3.01543	4.10494
36	3.03378	4.04730
37	3.10736	3.87117
38	3.00299	4.00000
39	3.0241	3.92169
40	3.14388	4.22302
41	3.01553	3.99689
42	3.01805	4.02888
43	2.83838	3.90236
44	2.96942	4.0948
45	3.05263	3.97523
46	3.04127	4.04444
47	2.88401	4.00940
48	3.07850	3.97270

The table above showed the household hunger score and food insecurity experience scale values from January 2017 to December 2020 with their respective long term averages. The HHS and FIES values were secondary data from NDMA which was used to come up with the FIES and HHS line trends shown below.

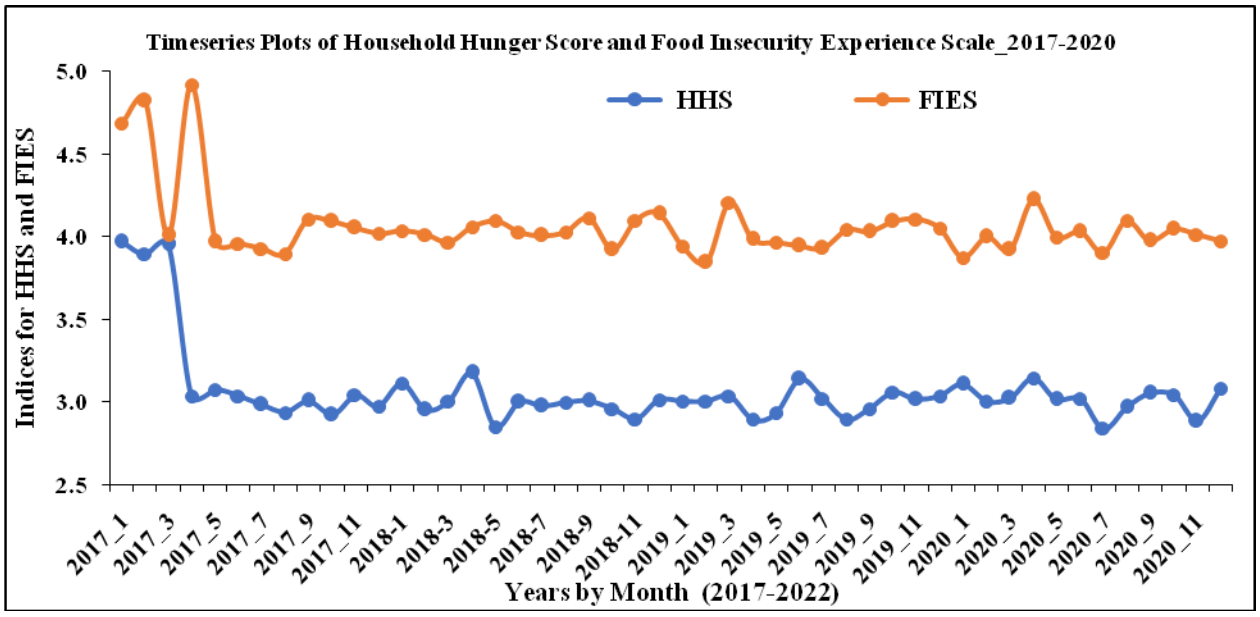

Figure 4.2: Time Series Plots of Household Hunger Scale (HHS) and Food Insecurity Experience Scale (FIES

Figure 4.2 depicted time series trends of household hunger score (HHS) and Food Insecurity Experience Scale (FIES) over time (January 2017-December 2020). The higher the household

hunger score and food insecurity experience scale, the more food insecure households are. From the figure show above, January and February 2017 posted FIES values which were above the long term average of 4.06 thus households were severely food insecure as a result of drought. Food Insecurity experience scale trend indicated that in the year 2017, majority of the households were severely food insecure attributable to failure of two consecutive rainy seasons. In the year 2018, households were moderately food insecure as the FIES values were within the normal value (long term mean) of 4.06, which was occasioned by exceedingly good performance of the long rains that improved food insecurity. However, the last quarter of 2019 was characterized by surge of food insecurity experience scale as majority of the households were overstretched and severely food insecure prompted by the effects of the long dry spell that spanned for a period of 6 months. Notably, household hunger score followed similar pattern of food insecurity experience scale as severe hunger at the household level was recorded in 2017 and towards the last quarter of 2019. There was an increase of FIES in the August 2020 occasioned by invasion of desert locust that decimated crops and livestock rangeland thus exposing households to pangs of hunger. According to the Desert Locust Global Analysis by FAO in 2020, a small third generation of breeding commenced in July 2020 in some parts of Marsabit County and other areas with residual swarms that limited the moisture needed for the hatching of laid eggs. A desert locust upsurge remained a threat to crop and rangeland resources throughout the period, particularly in the northeast and northwest parts of Marsabit County.

Table 4.6: Time Series plot of Household Dietary Diversity Score over time (January 2017-December 2020)

HDDS (Long Term Average=6.361723)			
Months	**HDDS**	**Months**	**HDDS**
1	4.90000	25	6.67584
2	4.66561	26	6.50155
3	5.03647	27	6.53963
4	5.09786	28	6.82000
5	5.68580	29	6.36842
6	5.06498	30	6.47147
7	6.06774	31	6.30303
8	6.03041	32	6.43769
9	6.19697	33	6.43151
10	6.06757	34	6.31464
11	6.29431	35	6.73457
12	6.55369	36	6.99662
13	6.19257	37	6.97239
14	6.09394	38	6.65373
15	6.06623	39	6.78313
16	6.55108	40	6.74101
17	6.49107	41	6.39130
18	6.47289	42	6.72202
19	6.46646	43	6.62290
20	6.44910	44	6.99694
21	6.59271	45	6.97523
22	6.58360	46	6.70476
23	6.75325	47	7.01881
24	6.62691	48	7.18430

The table above showed the household dietary diversity score values from January 2017 to December 2020 with their respective long term averages. The HDDS values were secondary data from NDMA which was used to come up with the HDDS line trends shown below.

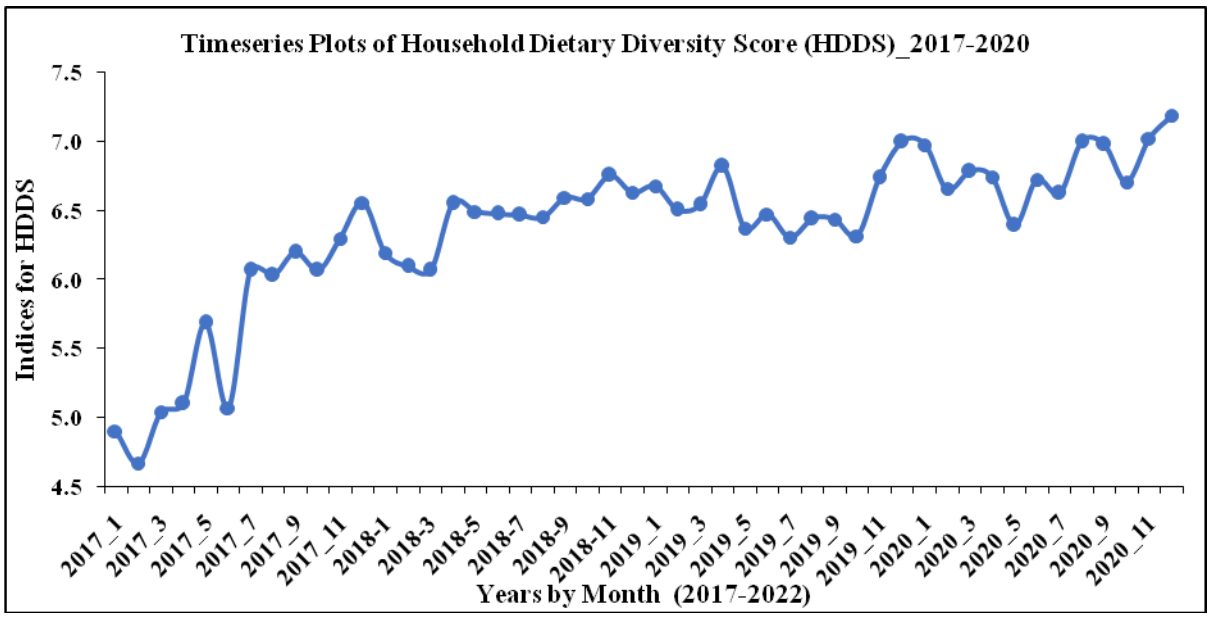

Figure 4.3: Time Series Plot of Household Dietary Diversity Score

Figure 4.3 depicted time series plot of household dietary diversity score. The higher the household dietary diversity score, the more food secure households are. Generally, households in the year 2017 consumed from limited food groups i.e. 5-6 food groups which indicated moderate food dietary diversity. Additionally, household dietary diversity score values from January-July 2017 were extremely low as their values were below the long term mean of 6.36. Below normal HDDS was attributed to the severe drought period that led to total crop failure, poor livestock productivity and increased food commodities prices. The year 2018 was characterized as generally a good year as majority of the households were food secure as manifested by the trend line which oscillated between 6.07 to 6.68 between January -December 2018 thus compared closely to the long term average HDDS value of 6.36 in the stated period. However, a dip in dietary diversity was noted in mid-2020 but was within the normal range of 6.36, which was a year that food consumption was constrained due to Covid-19 measures. Towards the last quarter of 2020, food dietary diversity improved due to the various safety net measures that were offered by the government and development partners to cushion the vulnerable households against the ravages of COVID-19 containment measures. According to FEWS NET food security outlook of July 2020, most parts Marsabit County, dietary diversity at household level were driven by high staple food prices, below-average income from non-

livestock related casual labor opportunities, and below-average remittances impacted by COVID-19, which restricted the affordability of food items.

Table 4.7: Augmented Dickey Fuller Test for Unit Root

Augmented Dickey Fuller Test for Unit Root						
Z (t) has t-distribution						
		Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Critical Value**	**P-value**
Household Dietary Diversity	Z (t)	-0.424	-2.602	-1.753	-1.341	0.3388
Coping Strategy Index	Z (t)	-0.155	-2.602	-1.753	-1.341	0.4393
Household Hunger Score	Z (t)	-2.025	-2.602	-1.753	-1.341	0.0305**
Food Insecurity Experience Scale	Z (t)	-1.391	-2.602	-1.753	-1.341	0.0923
Food Consumption Score	Z (t)	-2.096	-2.602	-1.753	-1.341	0.0268**

Note: ** denotes rejection of non-stationarity at 5% significance level

Table 4.7 shown above illustrated augmented Dickey-Fuller test for unit root was conducted to ascertain the food insecurity indicators that were stationary (follows a white noise). On the basis of the dickey fuller test, the assumption of non-stationary was rejected for the levels of food household hunger score and food insecurity experience scale as their p-values i.e. 0.0305 and 0.0268 associated with t-values were less than 0.05 less of significance. However, the p-values for household dietary diversity score, coping strategy index and food insecurity experience scale associated with the t-values were greater than 0.05 level of significance thus acceptance of the assumption of non-stationary. For time series forecasting, the non-stationary food insecurity indicators (household dietary diversity score, coping strategy index and food insecurity experience scale) cannot be used for ARIMA modelling as they are non-stationary. For stationary, first difference was subjected to household dietary diversity score, coping strategy index and food insecurity experience scale to convert them to stationary food insecurity indicators as indicated in table 4.8 shown below.

Table 4.8: First Difference Augmented Dickey Fuller Test for Unit Root

Augmented Dickey Fuller Test for Unit Root						
Z (t) has t-distribution						
		Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	P-value
D_Household Dietary Diversity	Z (t)	-5.814	-4.196	-3.52	-3.192	0.0000*
D_Coping Strategy Index	Z(t)	-6.032	-4.196	-3.52	-3.192	0.0000*
D_Food Insecurity Experience Scale	Z (t)	-5.556	-4.196	-3.52	-3.192	0.0000*

Note: ** denotes rejection of non-stationarity at 5% significance level

Food Insecurity Indicators (household dietary diversity score, coping strategy index and food insecurity experience scale) time series data were differenced with a lag of 1 to achieve stationarity. From the figure 4.3 shown above, it was deduced that the p-values of the three differenced food insecurity indicators were less than the 0.05 significance level thus time series stationary.

4.3.1 Model Identification

After achieving stationarity conditions for all the food insecurity indicators, ARIMA models were fitted and investigated for suitability. Correlogram (ac) and Partial Correlogram lag plots for the food insecurity indicators (Differenced Household Dietary Diversity Score, Differenced Food Insecurity Experience Scale, Household Hunger Score, Differenced Coping Strategy Index and Food Consumption Score) were plotted to obtain candidate models to be fitted in the time series analysis. For determination of parameter q for the ARIMA model, it was observed that there was only one spike for the respective food insecurity indicators that fell outside autocorrelation plot (gray area-95% confidence level band), the others were within the 95% confidence level band hence q=1. For determination of the number of partial autocorrelation (p) for the ARIMA model, it was observed that there was one spike for the respective food insecurity indicators that fell outside partial autocorrelation plot (gray area-95% confidence level band), the others were within the 95% confidence level band hence p=1.Thus the identified model for ARIMA is (1,1,1).

4.3.2 Model Estimation: Box Jenkins Test (ARIMA)

Table 4.9: Summary of the FCS ARIMA (1,1,1) modelling results

	D.fcs	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
FCS	_cons	0.389055	0.34902	1.11	0.265	-0.2950115	1.073122
ARMA							
	ar						
	L1.	0.069582	0.337999	0.21	0.837	-0.592884	0.732049
	ma						
	L1.	-0.3736	0.22021	-1.7	0.09	-0.8052082	0.058
	/sigma	3.52266	0.388807	9.06	0	2.760612	4.284709

Log pseudo likelihood = -125.9244 Wald chi2(2)=11.38 Prob >chi2 =0.0034

From the table shown above, the model is a good fit since Prob >chi2 =0.0034 is less than 0.05 level of significance. Some of the coefficients of the model (AR, MA) are statistically significant since their p-values are less than 0.05. Let X denote the Auto Regressive part and Z denote the Moving Average part. Then the model can be expressed as

Food Consumption Score (FCS)= 0.389055 + 0.069582$_{-1}$ + 1Z_t – 0.3736Z_t

Table 4.10: Summary of the HHS ARIMA (1,1,1) modelling results

	D.HHS	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
HHS	_cons	-0.01877	0.022023	-0.85	0.394	-0.0619378	0.024392
ARMA							
	ar						
	L1.	-0.85269	0.35297	-2.42	0.016	-1.544498	-0.16088
	ma						
	L1.	0.705135	0.472626	1.49	0.136	-0.2211943	1.631464
	/sigma	0.162844	0.018123	8.99	0	0.1273247	0.198364

Log pseudo likelihood = 18.53939 Wald chi2(2) =15.32 Prob>chi2 =0.0005

From the table shown above, the model is a good fit since Prob >chi2 =0.0005 is less than 0.05 level of significance. Some of the coefficients of the model (AR, MA) are statistically significant as their p-values are less than 0.05. Let X denote the Auto Regressive part and Z denote the Moving Average part. Then the model can be expressed as

Household Hunger Score (HHS)= -0.01877– 0.85269$_{-1}$ + 1Z_t+ 0.705135$_t$

Table 4.11: Summary of the Differenced CSI ARIMA (1,1,1) modelling results

Differenced_CSI	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
_cons	0.027637	0.121727	0.23	0.82	-0.21094	0.266217
ARMA						
ar						
L1.	-0.19576	0.660823	-0.3	0.767	-1.49095	1.099434
ma						
L1.	-0.86841	1.009389	-0.86	0.39	-2.84678	1.109953
/sigma	1.389725	0.176684	7.87	0	1.043432	1.736019

Log pseudo likelihood = -81.28937 Wald chi2(2) =24.85 Prob>chi2 = 0.0000

From the table shown above, the model is a good fit since Prob >chi2 =0.0000 is less than 0.05 level of significance. Coefficients of the model (AR, MA) are not statistically significant since their p-values are greater than 0.05. Let X denote the Auto Regressive part and Z denote the Moving Average part. Then the model can be expressed as

Differenced_CSI= 0.027637– 0.19576$_{_1}$ + 1Z_t- 0.86841$_t$

Table 4.12: Summary of the Differenced HDDS ARIMA (1,1,1) modelling results

Differenced_HDDS	Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]
_cons	-0.00221	0.0017715	-1.25	0.212	-0.00568	0.001262
ARMA						
ar						
L1.	-0.46538	0.162776	-2.86	0.004	-0.78442	-0.14635
ma						
L1.	-1	4.73E-07	-2.10E+06	0	-1	-1
/sigma	0.250523	0.0216665	11.56	0	0.208057	0.292988

Log pseudo likelihood = -4.020149 Wald chi2(2) = 4.53e+12 Prob>chi2 = 0.0000

From the table shown above, the model is a good fit since Prob >chi2 =0.0000 is less than 0.05 level of significance. All the coefficients of the model (AR, MA) are statistically significant since their p-values are less than 0.05. Let X denote the Auto Regressive part and Z denote the Moving Average part. Then the model can be expressed as

Differenced HDDS= -0.00221- 0.46538$_{_1}$ + 1Z_t- 1$_t$

Table 4.13: Summary of the Differenced FIES ARIMA (1,1,1) modelling results

Differenced_FIES	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
_cons	0.0011196	.0017807	0.63	0.53	-0.0023705	0.00461
ARMA						
ar						
L1.	-0.0233666	.1509894	-0.15	0.877	-0.3193004	0.272567
ma						
L1.	-1	-2.25e-07	4.5e+06	0	-1.000001	-1
/sigma	0.1924233	.0291366	6.60	0	0.1353167	0.24953

Log pseudo likelihood = 8.591511 Wald chi2(2) = 2.07e+13 Prob >chi2 = 0.0000

From the table shown above, the model is a good fit since Prob >chi2 =0.0000 is less than 0.05 level of significance. Some of the coefficients of the model (AR, MA) are statistically significant since their p-values are less than 0.05. Let X denote the Auto Regressive part and Z denote the Moving Average part. Then the model can be expressed as

Differenced FIES= 0.0011196- 0.0233666$_{-1}$ + 1Z_t- 1$_t$

4.4. Prevalence of food insecurity in Marsabit County

Table 4.14: Prevalence of food insecurity in Marsabit County

`				Mean	Long Term Mean
Food Consumption Score	**Poor**	**Borderline**	**Acceptable**		
	7 (0.87)	145 (45.17)	170 (52.96)	37.5578	39.5776
Coping Strategy Index	**Minimal**	**Stress**	**Crisis**		
	34 (10.28)	191(59.50)	97(30.22)	17.3454	18.27096
Household Hunger Score	**No Hunger**	**Moderate Hunger**	**Severe Hunger**		
	45 (13.71)	148(46.11)	129(40.19)	2.8923	3.0605
Household Dietary Diversity Score	**Low Dietary Diversity**	**Moderate Dietary Diversity**	**High Dietary Diversity**		
	3(0.62)	100(31.15)	219(68.22)	6.0156	6.3617
Household Food Insecurity Experience Scale	**Food Security**	**Moderate Food Insecurity**	**Severe Food Insecurity**		
	123(38.32)	191(59.50)	7(2.18)	3.8783	4.0745

Percentages in parenthesis ()

The prevalence of food insecurity was computed majorly from the data collected during the study across Marsabit County. Food consumption score was computed and categorized into the universal three categories of poor, borderline and acceptable food consumption score categories. From the table shown above; 1%, 45% and 53% of the households had poor, borderline and acceptable food consumption scores respectively. Therefore, 1% of households consumed staples and vegetables every day and never or very rarely are consuming protein rich food such as meat and dairy. 45% percent of the households consumed staples and vegetables every day, accompanied by oil and pulses a few times a week while 53% percent consumed staples and vegetables every day, regularly accompanied by oil and pulses and occasionally meat or dairy product. The mean of food consumption score was 37.56 which placed the majority of the households in the acceptable food consumption band which implied that most of the households were food secure. Although the mean food consumption score of 37.56 fell below the long term mean of 39.58, households had minimal food consumption gaps in the month of April 2021 occasioned by the cumulative effect of the previous season which sustained the drought status to moderate phase.

The coping strategy index was computed where 10%, 60% and 30% of the households applied minimal, stressed and crisis coping strategies when they lacked food or money to buy food. 10% of the households who adopted minimal coping strategies implied that the adoption of the mechanism was less frequent and severe. Notably, 30% of the households who had crisis coping strategies meant that they applied severe reversible mechanisms more frequently when they lacked food or money to buy food. The main coping strategies employed by households were reliance on less preferred and less expensive foods, borrowing food or rely on help from friends or relatives, limit portion size at mealtime, restriction of consumption by adults in order for small children to eat and reduction in the number of meals eaten in daily in a seven-day recall period. The mean coping strategy index was 17.34 which implied that majority of the households applied stressed coping mechanisms such as borrowing food or rely on help from friends or relatives and reduction in the number of meals. However, mean coping strategy index of 17.34 was below the long term average of 18.27 which indicated that households were less food insecure when compared to normal periods.

The household hunger scale indicated that 14% of the households had no hunger, 46% of the households experienced moderate hunger while 40% had severe hunger in the past 30 days. The mean household hunger scale was 2.89 which was slightly lower than the long term average of 3.06 which was an indication of moderate hunger at household level during the study period. Household dietary diversity score indicated that 1% of the households consumed from limited food groups (low dietary diversity), 31% of the households had moderate dietary diversity while 68% posted high dietary diversity which implied that majority of the households consumed from more than 6 food groups. The mean household dietary diversity score of 6.016 compared closely to the long term average of 6.36 which illustrated that majority of households consumed on average six food in a day hence less food insecure. The food insecurity experience scale indicates that 38% of the households were food secure. Notably, 60% of the households were moderately food insecure which implied that households typically consumed low quality diets and might have been forced, at times during the year, to also reduce the quantity of food they would normally eat, while 2% of the households were severely food insecure (experienced severe levels would had gone for entire days without eating, due to lack of money or other resources to obtain food). The mean food insecurity experience scale was 3.87 which was slightly lower than the long term average of 4.07. The mean FIES of 3.87 indicated that households were moderately food insecure.

4.5 Determinants/Causes of household food insecurity in Marsabit County

Table 4:15. Ordinal Logistic Regression between outcome variable (FCS) and control variables

Food Consumption Score (FCS)	Coefficient	Std.Err	Z	P>z	[95% Conf.	Interval]
Education level of household head						
1=Primary(Ref.)						
2=Secondary	0.9971	0.9045	1.1000	0.2700	-0.7756	2.7699
3=Tertiary training	-4.0139*	0.6630	-6.0500	0.0000	-5.3134	-2.7143
4=University	14.9578*	1.4785	10.1200	0.0000	12.0600	17.8556
5=None	-0.2238	0.4957	-0.4500	0.6520	-1.1954	0.7477
Main source of income						
1=Employment(Ref.)						
2=Sale of livestock	1.8840*	1.1234	1.6800	0.0140	-0.3178	4.0857
3=Sale of crops	15.5784*	1.5428	10.1000	0.0000	12.5545	18.6023
4=Casual labour	0.4473	1.1077	0.4000	0.6860	-1.7238	2.6183
5=Trade	-1.4292	1.1309	-1.2600	0.2060	-3.6458	0.7875
Gender of household head						
1=Male(Ref.)						
2=Female	0.4024	0.3930	1.0200	0.3060	-0.3678	1.1727
Main source of water						
1=Boreholes						
2=Natural ponds	2.4963	1.3120	1.9000	0.0570	-0.0751	5.0677
3=Water pans	0.6484*	0.5242	1.2400	0.0160	-0.3791	1.6759
4=Piped water	-1.2371*	0.5758	-2.1500	0.0320	-2.3656	-0.1087
5=Seasonal rivers	0.9788	0.7221	1.3600	0.1750	-0.4366	2.3941
6=Shallow wells	-1.7231*	0.6177	-2.7900	0.0050	-2.9339	-0.5123
7=Traditional river wells	-0.5620	0.6857	-0.8200	0.4120	-1.9060	0.7820
Distance to water source	0.0040	0.0581	0.0700	0.0946	-0.1100	0.1179
Cattle price	0.0000	0.0000	0.0000	0.9980	-0.0001	0.0001
Goat price	-0.0001	0.0002	-0.0400	0.7920	-0.0004	0.0003
Camel price	0.0000	0.0000	-1.0200	0.3080	0.0000	0.0000
Milk price	-0.0167	0.0290	-0.5800	0.5650	-0.0736	0.0402
Milk produced	-0.1255*	0.0707	-1.7700	0.0360	-0.2641	0.0131
Milk consumed	-0.1186	0.1016	-1.1700	0.2430	-0.3177	0.0805
Tropical livestock unit cattle	-0.0099	0.0273	-0.0300	0.7160	-0.0634	0.0436
Tropical livestock unit goat	-0.0465	0.0688	-0.0080	0.6430	-0.1813	0.0883
Tropical livestock unit sheep	0.0693	0.0925	0.7500	0.4540	-0.1120	0.2507
Tropical livestock unit camel	-0.0290	0.0294	-0.9900	0.5230	-0.0866	0.0285

Log pseudo likelihood = -176.78356 Prob > chi2 =0.0000 PseudR2=0.2848

***=significance**

From the output above, the portion of the output results from a likelihood ratio chi-square test, compared the fit model with the complete set of predictors with an intercept-only, or null, model (no predictors). Since the p-value is less than 0.005, the model containing the full set of predictors represents an association. Based on the McFadden's pseudo R-square (McFadden value of 0.2–0.4 indicates a good fit), the full model containing predictors represented 28.5% improvement in fit relative to the null model thus indicative of a good fit. For educational level of household head, coefficients of tertiary training and university were negative and positive respectively and significant. Therefore, for one-unit increase in university, the log odds of a household head attaining university education was predicted to improve food consumption score by 15. However, for one-unit increase in tertiary education, the log odds of a household head attaining tertiary education is predicted to decrease food consumption score by 4. For household main source of income, coefficients of sale of livestock and sale of crops are positive and significant. Therefore, for one-unit increase in sale of livestock and crops, the log odds of a household predicted to improve food consumption score by 1.9 and 15.6 respectively. These results are in line with findings of household food security status and its determinants in Maphumulo local municipality, South Africa(2018) which indicated that the variable household income was found to be significant at the 1% level ($p = 0.000$) and had a positive correlation with the household food consumption score, with a beta coefficient (β) = 0.004 and an odds ratio ($Exp(\beta)$) = 0.996. The model predicted that for a one unit increase in income by a household, the household would be more likely to be food secure by 0.006 times while holding all other independent factors constant. Additionally, the variable education status was also found to be significant at the 5% level ($p = 0.036$) and was positively correlated with the household food consumption score, as was expected, with a beta coefficient (β) = 0.817 and an odds ratio ($Exp(\beta)$) = 2.264. The model predicts that educational status would increase the odds of a household to be food secure while holding all other independent factors constant which is in tandem with the findings. The results indicated that female gender was not significant and didn't associate to food consumption score. For main source of water, coefficients of natural ponds and shallow wells are positive and negative respectively and significant. The coefficients of tropical livestock units and livestock prices are not significant hence no association with food consumption score.

Table 4:16. Ordinal Logistic Regression between outcome variable (CSI) and control variables

Coping Strategy Index (CSI)	Coefficients	Std.Err	Z	P>z	[95% Conf.	Interval]
Education level of household head						
1=Primary(Ref.)						
2=Secondary	-0.3819	0.6590	-0.5800	0.5620	-1.6735	0.9097
3=Tertiary training	0.1578	0.6860	0.2300	0.8180	-1.1867	1.5023
4=University	-2.7675*	0.9690	-2.8600	0.0040	-4.6666	-0.8684
5=None	-0.3007	0.5604	-0.5400	0.5920	-1.3990	0.7977
Main source of income						
1=Employment(Ref.)						
2=Sale of livestock	0.9055*	0.4752	1.9100	0.0470	-0.0258	1.8368
3=Sale of crops	-0.6199	0.6295	-0.9800	0.3250	-1.8538	0.6139
4=Casual labour	0.5658	0.4953	1.1400	0.2530	-0.4050	1.5366
5=Trade	1.5887*	0.5606	2.8300	0.0050	0.4899	2.6875
Gender of household head						
1=Male(Ref.)						
2=Female	-0.3305	0.4072	-0.8100	0.4170	-1.1286	0.4675
Main source of water						
1=Boreholes(Ref.)						
2=Natural ponds	0.3185	0.8664	0.3700	0.7130	-1.3796	2.0166
3=Water pans	-2.9104*	0.8095	-3.6000	0.0000	-4.4970	-1.3237
4=Piped water	-1.5189*	0.7560	-2.0100	0.0450	-3.0007	-0.0370
5=Seasonal rivers	-6.1215*	1.1995	-5.1000	0.0000	-8.4725	-3.7704
6=Shallow wells	-1.4294	0.7751	-1.8400	0.0650	-2.9487	0.0898
7=Traditional river wells	-2.6647*	0.9692	-2.7500	0.0040	-4.5643	-0.7652
Distance to water source	0.3739*	0.0889	4.2100	0.0000	0.1997	0.5481
Cattle price	0.0000	0.0000	0.1800	0.8590	0.0000	0.0001
Goat price	0.0002	0.0002	0.9600	0.3350	-0.0002	0.0005
Camel price	0.0000	0.0000	-1.0200	0.3070	0.0000	0.0000
Milk price	-0.0167	0.0281	-0.6000	0.5520	-0.0717	0.0383
Milk produced	0.0197	0.0666	0.3000	0.7680	-0.1108	0.1501
Milk consumed	-0.0338	0.0946	-0.3600	0.7210	-0.2193	0.1516
Tropical livestock unit cattle	0.0105	0.0251	0.4200	0.6750	-0.0386	0.0596
Tropical livestock unit goat	0.0501	0.0607	0.8200	0.4100	-0.0690	0.1691
Tropical livestock unit sheep	-0.0451	0.0864	-0.5200	0.6010	-0.2146	0.1243
Tropical livestock unit camel	-0.0109	0.0273	-0.4000	0.6900	-0.0644	0.0426

Log pseudo likelihood = -210.91219Prob > chi2 =0.0044 PseudR2=0.2735

***=significance**

From the output above, the portion of the output results from a likelihood ratio chi-square test, compares the fit model with the complete set of predictors with an intercept-only, or null, model (no predictors). Since the p-value is less than 0.05, the model containing set of predictors represents some association. The full model containing predictors represents 27.4% improvement in fit relative to the null model thus indicative of a good fit. For educational level of household head, coefficient of university is negative and significant. Therefore, for one-unit increase in university, the log odds of a household head attaining university education is predicted to deteriorate the coping strategy index by 2.8. However, coefficients of secondary and tertiary level of education were not significant thus no association with coping strategy index. For household main source of income, coefficients of sale of livestock and trade are positive and significant. Therefore, for one-unit increase in sale of livestock and trade, the log odds of a household predicted to increase the coping strategy index by 1.0 and 1.6 respectively. However, casual labour and sale of crops are not significant hence no association with the predicted variable coping strategy index. Similarly, female gender is not significant and doesn't associate to coping strategy index. For main source of water, coefficients of water pans, piped water, traditional river wells and seasonal rivers are negative and significant thus a worsening association to the predicted coping strategy index. The coefficients of tropical livestock units and livestock prices are not significant hence no association with coping strategy index.

A study in Kenya found somewhat related results in that coping strategy index was positively but weakly correlated with livestock income(Maxwell et al. 2003); however, that study did not take seasonal effects into consideration. The current study showed that pastoralists probably attached more importance to belonging to socio economic factors. Coping strategy index is an indicator of short-term food security status, providing baseline information from the surveys in two different seasons. Subsequent surveys carried out at the same time of the year could track impact of development projects directed at household food security, as was recommended by Maxwell et al. (2003). The findings of this study emphasize what Ahamad and Khondker (2010) noted that food insecurity is often transitory as a result of fluctuations of coping strategies, which may be an outcome of socioeconomic circumstances and variation in climatic factors.

Table 4:17. Ordinal Logistic Regression between outcome variable (HDDS) and control variables

Household Dietary Diversity Score (HDDS)	Coefficient	Std.Err	Z	P>z	[95% Conf.	Interval]
Education level of household head						
1=Primary(Ref.)						
2=Secondary	0.2982	1.3582	0.2200	0.8260	-2.3638	2.9601
3=Tertiary training	-3.2980*	0.8130	-4.0600	0.0000	-4.8914	-1.7046
4=University	1.3045	1.5939	0.8200	0.4130	-1.8195	4.4286
5=None	-1.1108*	0.5551	-2.0000	0.0450	-2.1988	-0.0227
Main source of income						
1=Employment(Ref.)						
2=Sale of livestock	1.0739	1.1025	0.9700	0.3300	-1.0870	3.2348
3=Sale of crops	-1.7174	1.4303	-1.2000	0.2300	-4.5208	1.0860
4=Casual labour	-0.3461	1.3394	-0.2600	0.7960	-2.9713	2.2791
5=Trade	-0.2844	1.1303	-0.2500	0.8010	-2.4997	1.9309
Gender of household head						
1=Male(Ref.)						
2=Female	-0.6802	0.4727	-1.4400	0.1500	-1.6068	0.2463
Main source of water						
1=Boreholes(Ref.)						
2=Natural ponds	6.8200*	1.5170	4.5000	0.0000	3.8467	9.7934
3=Water pans	4.2605*	1.2835	3.3200	0.0010	1.7448	6.7762
4=Piped water	3.0274*	0.9527	3.1800	0.0010	1.1602	4.8947
5=Seasonal rivers	0.4336	1.0022	0.4300	0.6650	-1.5306	2.3978
6=Shallow wells	2.7415*	1.0178	2.6900	0.0070	0.7466	4.7364
7=Traditional river wells	1.8056*	0.9497	1.9000	0.0470	-0.0558	3.6671
Distance to water source	-0.0433	0.0652	-0.6600	0.5060	-0.1712	0.0845
Cattle price	0.0000	0.0000	-0.1900	0.8480	-0.0001	0.0001
Goat price	-0.0003	0.0003	-0.9400	0.3490	-0.0008	0.0003
Camel price	0.0000	0.0000	0.7600	0.4450	0.0000	0.0001
Milk price	-0.0111	0.0401	-0.2800	0.7820	-0.0898	0.0675
Milk produced	-0.1541	0.1075	-1.4300	0.1520	-0.3648	0.0566
Milk consumed	0.0433	0.1435	0.3000	0.7630	-0.2379	0.3245
Tropical livestock unit cattle	0.0123	0.0424	0.2900	0.7710	-0.0708	0.0954
Tropical livestock unit goat	-0.0319	0.0921	-0.3500	0.7290	-0.2125	0.1487
Tropical livestock unit sheep	0.0433	0.1135	0.3800	0.7030	-0.1791	0.2658
Tropical livestock unit camel	-0.0352	0.0452	-0.7800	0.4360	-0.1237	0.0534

Log pseudo likelihood = -105.03288Prob > chi2 = 0.0000 Pseudo R2 = 0.3272

From the output above, the portion of the output results from a likelihood ratio chi-square test, compared the fit model with the complete set of predictors with an intercept-only, or null, model (no predictors). Since the p-value was less than 0.05, the model containing set of predictors represented some association. The full model containing predictors represented 32.8% improvement in fit relative to the null model hence illustrative of a good fit. For tertiary training

and no education acquired by household head had negative coefficients and significant. Therefore, for one-unit increase in tertiary training and no education, the log odds of predicted household dietary diversity score declined by 3.3 and 1.1 respectively. However, coefficients of secondary and university levels of education were positive and not significant thus no association with household dietary diversity score. Coefficients of household sources of income and female gender were not significant hence no relationship with household dietary diversity score. For main sources of water, coefficients of natural ponds, water pans, piped water and traditional river wells were positive and significant thus an increased association to the predicted household dietary diversity score. The coefficients of tropical livestock units, milk production, milk consumption and livestock prices were not significant thus no association with household dietary diversity score.

With regard to education, previous studies suggest correlation with household dietary diversity score (Thiele and Weiss, 2003; Thorne-Lyman et al,2009; Taruvinga et al, 2013). Several studies show relationship between level of education and dietary diversity score (Smith and Haddad,2000; Smith et al, 2003) and this is in consonance to the research findings.

Table 4:18. Ordinal Logistic Regression between outcome variable (HHS) and control variables

Household Hunger Score (HHS)	Coefficient	Std.Err	Z	P>z	[95% Conf.	Interval]
Education level of household head						
1=Primary(Ref.)						
2=Secondary	-0.9509	0.7308	-1.3000	0.1930	-2.3833	0.4815
3=Tertiary training	13.3258*	1.1288	11.8100	0.0000	11.1134	15.5383
4=University	0.2623	1.4893	0.1800	0.8600	-2.6567	3.1813
5=None	-0.0239	0.3758	-0.0600	0.9490	-0.7604	0.7125
Main source of income						
1=Employment(Ref.)						
2=Sale of livestock	-1.1121	0.9994	-1.1100	0.2660	-3.0709	0.8467
3=Sale of crops	12.4139*	1.4608	8.5000	0.0000	9.5507	15.2770
4=Casual labour	-0.6848	0.9484	-0.7200	0.4700	-2.5437	1.1741
5=Trade	-1.5587	1.0216	-1.5300	0.1270	-3.5609	0.4435
Gender of household head						
1=Male(Ref.)						
2=Female	-0.0581	0.3234	-0.1800	0.8570	-.69194	.57576
Main source of water						
1=Boreholes(Ref.)						
2=Natural ponds	-1.1835*	0.5670	-2.0900	0.0370	-2.2948	-0.0721
3=Water pans	-1.1908*	0.4223	-2.8200	0.0050	-2.0185	-0.3631
4=Piped water	-1.6598*	0.5261	-3.1500	0.0020	-2.6910	-0.6286
5=Seasonal rivers	-1.4871*	0.6424	-2.3100	0.0210	-2.7463	-0.2279
6=Shallow wells	-1.3759*	0.7033	-1.9600	0.0500	-2.7545	0.0026
7=Traditional river wells	-0.5414	0.6240	-0.8700	0.3860	-1.7644	0.6816
Distance to water source	0.0259	0.0436	0.5900	0.5530	-0.0596	0.1113
Cattle price	0.0000*	0.0000	2.0700	0.0380	0.0000	0.0001
Goat price	-0.0001	0.0002	-0.4400	0.6580	-0.0004	0.0002
Camel price	0.0000	0.0000	-0.8200	0.4140	0.0000	0.0000
Milk price	-0.0085	0.0248	-0.3400	0.7310	-0.0571	0.0401
Milk produced	-0.0373	0.0581	-0.6400	0.5210	-0.1511	0.0766
Milk consumed	0.0752	0.0851	0.8800	0.3770	-0.0916	0.2421
Tropical livestock unit cattle	0.0268	0.0225	1.1900	0.2350	-0.0174	0.0709
Tropical livestock unit goat	-0.0367	0.0564	-0.6500	0.5150	-0.1472	0.0738
Tropical livestock unit sheep	0.0040	0.0774	0.0500	0.9590	-0.1478	0.1557
Tropical livestock unit camel	0.0063	0.0242	0.2600	0.7950	-0.0411	0.0537

Log pseudo likelihood = -302.2599 Prob > chi2 = 0.055 Pseudo R2 = 0.0543

From the output above, since the p-value is slightly greater than 0.05, the model containing the full set of predictors thus represents partial association. Based on the McFadden's pseudo R-square (McFadden value of 0.2–0.4 indicates a good fit), model containing predictors represents

5.4% improvement in fit relative to the null model hence indicative of a poor fit. For educational level of household head, coefficient of tertiary training is positive and significant. Therefore, for one-unit increase in tertiary training, the log odds of predicted household hunger score to improves by 13. This corroborates with (Kirimil et al., 2013; Olabisi et al., 2014; Nkegbe et al., 2017; Tefera and Tefera, 2014; Oluwatayo, 2008; Asogwa and Umeh, 2012; Fawehinmi and Adeniyi, 2014; Adeniyi and Ojo, 2013; Abdullah et al., 2017; Asghar and Muhammad, 2013; Amaza et al., 2006; Asghar and Muhammad, 2013; Bashir et al., 2013a; 2012; Gebre, 2012; Idrisa et al., 2008; Kaiser et al., 2003; Makombe et al., 2010). However, coefficients of secondary, university and none education are not significant thus no association to the household hunger score. For household main source of income, coefficient of sale of crops is positive and significant. Therefore, for one-unit increase in sale of crops, the log odds of a household predicted household hunger score improves by 12. However, sale of livestock, casual labour and trade are not significant hence no association with the predicted variable household hunger score. Similarly, female gender is not significant and doesn't associate to household hunger score. For main sources of water, coefficients of natural ponds, shallow wells, water pans, piped water and seasonal rivers are negative and significant. The coefficients of household distances to water sources, goat price, camel price, milk price, milk production and tropical livestock units are not significant hence no association with household hunger score with exception of coefficient of cattle price which is positive and significant hence relationship with household hunger score.

Table 4:19: Ordinal Logistic Regression between outcome variable (FIES) and control variables

Food Insecurity Experience Scale(FIES)	Coeffiecient	Std.Err	Z	P>z	[95% Conf.	Interval]
1=Primary(Ref.)						
2=Secondary	-0.9704599	0.620138	-1.56	0.12	-2.18591	0.244987
3=Tertiary training	-13.59516	1.140638	-11.9	0.00	-15.8308	-11.3596
4=University	0.0851443	0.814098	0.1	0.92	-1.51046	1.680746
5=None	-0.4881298	0.361621	-1.35	0.18	-1.1969	0.220635
Main source of income						
1=Employment(Ref.)						
2=Sale of livestock	-0.6377	0.643774	-0.99	0.32	-1.89947	0.624074
3=Sale of crops	-0.1976606	0.713914	-0.28	0.78	-1.59691	1.201584
4=Casual labour	-0.3773586	0.657216	-0.57	0.57	-1.66548	0.910762
5=Trade	-0.2326778	0.63828	-0.36	0.72	-1.48368	1.018328
Gender of household head						
1=Male(Ref.)						
2=Female	-0.0548425	0.309969	-0.18	0.86	-0.66237	0.552686
Main source of water						
1=Boreholes(Ref.)						
2=Natural ponds	-0.3169223	0.521069	-0.61	0.54	-1.3382	0.704355
3=Water pans	0.2133003	0.386085	0.55	0.58	-0.54341	0.970013
4=Piped water	-0.2171362	0.525844	-0.41	0.68	-1.24777	0.813499
5=Seasonal rivers	-0.1710015	0.564561	-0.3	0.76	-1.27752	0.935518
6=Shallow wells	0.0034754	0.483686	0.01	0.99	-0.94453	0.951483
7=Traditional river wells	0.1549384	0.500496	0.31	0.76	-0.82602	1.135892
Distance to water source	0.0069996	0.048513	0.14	0.89	-0.08808	0.102084
Cattle price	-0.0000187	2.42E-05	-0.77	0.44	-6.6E-05	2.87E-05
Goat price	-0.0000769	0.000157	-0.49	0.62	-0.00038	0.00023
Camel price	-0.000015	1.28E-05	-1.17	0.24	-4E-05	1.01E-05
Milk price	-0.013056	0.024439	-0.53	0.59	-0.06095	0.034843
Milk produced	0.0086999	0.058605	0.15	0.88	-0.10616	0.123563
Milk consumed	0.0288155	0.079063	0.36	0.72	-0.12615	0.183776
Tropical livestock unit cattle	-0.0045008	0.022696	-0.2	0.84	-0.04898	0.039982
Tropical livestock unit goat	0.0320618	0.054885	0.58	0.56	-0.07551	0.139634
Tropical livestock unit sheep	-0.0011815	0.07289	-0.02	0.99	-0.14404	0.14168
Tropical livestock unit camel	-0.0056028	0.024531	-0.23	0.82	-0.05368	0.042477

Log pseudo likelihood = -305.42761 Prob > chi2 = 0.099 Pseudo R2 = 0.0259

From the output above, the p-value is greater than 0.005, the model containing the full set of predictors represents doesn't represent association. Based on the McFadden's pseudo R-square (McFadden value of 0.2–0.4 indicates a good fit), the full model containing predictors represents 2.6% improvement in fit relative to the null model thus indicative of a poor fit. For educational

level of household head, coefficient of tertiary training is negative and significant. Therefore, for one-unit increase in tertiary training, the log odds of predicted food insecurity experience scale declines by 13.6. However, coefficients of secondary, university and none education are not significant thus no association to the food insecurity experience scale. Coefficients of main sources of income, female gender of household head, main water sources, distance to water sources, livestock prices, milk price, milk produced, milk consumed and tropical livestock units for cattle, goats, sheep and camel are not significant thus doesn't represent any association to the food insecurity experience scale at the household level.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes the findings, conclusions, recommendations and necessary suggestions for further research in line with the objectives of the study. Key objectives of the study were to assess temporal variation of food insecurity in the period 2017-2020 in Marsabit County, to estimate the prevalence of food insecurity in Marsabit County and to identify the key causes of household food insecurity in Marsabit County.

5.2 Summary of Findings

A drastic decline in the food consumption score was noted in February 2017 because of the severe drought which was occasioned by two consecutive failure of rainy seasons that led to less frequent food consumption at household level. However, there were a myriad of food interventions (relief food distributed by National Government, County Government, UN Agencies and NGOs) that gradually improved the food consumption score in the months of March, April and May 2017. Spikes were witnessed in the year 2020 which was an indicative of the effects of COVID-19 containment measures and desert locust invasion that negatively affected food consumption at the household level but still fell above the long term average. Coping strategy index was at an-time high on January 2017 at 34.04 which is significantly above the long term average. The coping strategy index of 34.04 implied that households adopted emergency coping mechanisms such as restriction of adult consumption for children during the severe drought period which is in tandem with the short rains assessment conducted in 2017. In the period 2020, coping strategies index posted a stable trend which implied that there was no change in the coping strategies as households adopted mechanisms to survive with less. January and February 2017 posted FIES values which were above the long term average of 4.06 thus households were severely food insecure as a result of drought. Food Insecurity experience scale trend indicated that in the year 2017, majority of the households were severely food insecure attributable to failure of two consecutive rainy seasons. Notably, household hunger score followed similar pattern of food insecurity experience scale as severe hunger at the household level was recorded in 2017 and towards the last quarter of 2019.

Household dietary diversity score values from January-July 2017 were extremely low as their values were below the long term mean of 6.36. Below normal HDDS was attributed to the severe drought period that led to total crop failure, poor livestock productivity and increased food commodities prices. The year 2018 was characterized as generally a good year as majority of the households were food secure as manifested by the trendline which oscillated between 6.07 to 6.68 between January -December 2018 thus compared closely to the long term average HDDS value of 6.36 in the stated period. However, a dip in dietary diversity was noted in mid-2020 but was within the normal range of 6.36, which was a year that food consumption was constrained due to Covid-19 measures. In accordance with ARIMA model assumptions of time series: white noise assumed that the residuals have zero mean, constant variance and the autocorrelation of any observations of such sequence always zero (uncorrelated). With the help of the ACF and PACF, tentative models were fit to the data. ARIMA (1, 1,1) was noted to fit the data well. Further adequacy test on the model also confirmed the validity of the selected model.

The mean of food consumption score was 37.56 which placed the majority of the households in the acceptable food consumption band which implied that most of the households were food secure. Although the mean food consumption score of 37.56 fell below the long term mean of 39.58, households had minimal food consumption gaps in the month of April 2021 occasioned by the cumulative effect of the previous season which sustained the drought status to moderate phase. Educational level of household head, coefficients of tertiary training and university were negative and positively correlated respectively and significant. For household main source of income, coefficients of sale of livestock and sale of crops were positive and significant with the outcome variable food consumption score.

For coping strategy index; coefficient of university level of education was negative and significant. Coefficients of sale of livestock and trade were positive and significant. However, casual labour and sale of crops are not significant hence no association with the predicted variable coping strategy index. Similarly, female gender is not significant and doesn't associate to coping strategy index. For main source of water, coefficients of water pans, piped water, traditional river wells and seasonal rivers are negative and significant thus a worsening association to the predicted coping strategy index.

5.3 Conclusions

In this study, the overall prevalence of household food insecurity was moderate. The community was exposed to multiple hazards of drought, COVID-19 pandemic, conflict and desert locust invasion. Moderate proportions of households had tried to manage the stress of food insecurity through reduction in diet quality and then quantity based on level of severity. Spikes of food insecurity were witnessed in a good year of 2020 which was an indicative of the effects of COVID-19 containment measures and desert locust invasion that negatively affected food consumption at the household level but still fell above the long term average. Common coping strategies that households applied were reliance on inferior food, purchase of food on credit and borrowing of food from either friends or relatives. There was an increase of FIES in the August 2020 occasioned by invasion of desert locust that decimated crops and livestock rangeland thus exposing households to pangs of hunger. According to the Desert Locust Global Analysis by FAO in 2020, a small third generation of breeding commenced in July 2020 in some parts of Marsabit County and other areas with residual swarms limited the moisture needed for the hatching of laid eggs. A desert locust upsurge remained a threat to crop and rangeland resources throughout the period, particularly in the northeast and northwest parts of Marsabit County. Subsequent surveys carried out at the same time of the year could track impact of development projects directed at household food security, as was recommended by Maxwell et al. (2003). The findings of this study emphasized what Ahamad and Khondker (2010) noted that food insecurity is often transitory as a result of fluctuations of coping strategies, which may be an outcome of socioeconomic circumstances and variation in climatic factors.

Although the mean food consumption score fell outside the normal ranges, households had minimal food consumption gaps during the data collection period occasioned by the cumulative effect of the previous season which sustained the drought status to moderate phase and adoption of the coping mechanisms were less frequent and severe. However, mean coping strategy index of was below the long term average which indicated that households were less food insecure when compared to normal periods. Household hunger was at moderate levels during the study period and majority of households recorded high dietary diversity of 6 food groups in a recall period of 24 hours.

For the dependent variable food consumption score; tertiary training, university degree, sale of livestock, sale of crops and water sources such as natural ponds and shallow wells were significant and thus showed a relationship. University educational level of household head, sale of livestock, trade and sources of water for households such as water pans, piped water, traditional river wells and seasonal rivers were significant thus showed an association with the predicted variable coping strategy index. Most of the indicators showed minimal association with the outcome variable food insecurity experience scale.

5.4 Recommendations

The recommendations by the researcher are that measures of food insecurity experience scale and food consumption score should be revised. For example, households just consuming meat and milk only without other food groups posted higher food consumption score as milk and meat have higher weights of 4 as opposed to vegetables and fruits which have weights of one which might not depict the accurate household food security status.

Based on the current comparative analysis, this study recommends using the HHS in emergency situations to inform programs to primarily save lives, since it is designed to pick up only the most-severe behaviors in response to household food insecurity. Extensive cross-sectoral interventions are required to mitigate accelerated deterioration in household food security. Already households are employing unsustainable coping strategies that are detrimental to household food security and future production prospects.

There was moderate prevalence of food insecurity in study areas and some factors that caused food insecurity in Marsabit especially those that were significant. It was noted that food insecurity impact indicators such as sources of income main water sources and educational levels had greater association to the predicted food insecurity indicators as opposed to production and access indicators. Therefore, to lessen food insecurity in Marsabit County, stakeholders should invest in direct impact indicators especially on educational level of households, income sources and water sources that can improve food security levels.

5.5 Suggestions for further Research

Further research is recommended to address the temporal patterns of food insecurity especially on the cross-cultural outcome indicators of household hunger scale and food insecurity

experience scale. Future research should build upon this work and focus on filling the critical research gaps, harmonizing indicators, and ensuring coordination among actors at all levels, including in research, practice, and policy. The study did not attempt to consider the nutritional contents of the food (it only focused on the calorific content) the nutritional aspects of food security should be further researched. The consolidated approach for reporting food security indicators is recommended for supporting long-term chronic food insecurity interventions and the household hunger score for food security assessments to inform emergency relief operations.

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APPENDICES

Appendix1: Questionnaire

Household Questionnaire

1. BACKGROUND INFORMATION
1. Ward Name […….] **2. Date of Interview (DD/MM/YYYY): [……/……/…….]** **3. Name of Respondent [……]** **4. Gender of Respondent;** Male […...] Female […...] 5**. Level of Education HH head 1.**Primary 2.Secondary 3.University 4.No Education **6.What is the main source of income for the household 1**.Employment/salary 2.Sale of livestock and livestock products 3.Sale of crops 4.Casual labour 5.Trade

2.1 Livestock species	**2.2 Number kept today**	**2.3 Number Sold in the last 1 month**	**2.4 Average price per livestock sold**
Total **Cattle**			
Total **Camels**			
Total **Goats**			
Total **Sheep**			

2.5 What is the total amount of milk produced in a household in a day in litres?.....

2.6 What is the total amount of milk consumed in a household in a day in litres?.....

2.7 What is the main source of income for the household in the 1 month?

1. Sale of crops 2. Sale of livestock 3. Sale of livestock products 4. Casual labour
5. Sale of wood 6. Sale of charcoal 7. Remittances 8. Employment income 9. Others

2.**8 What are the 3 main water sources for the household over the last 4 weeks**

1. Rivers 2. Traditional river wells. 3. Natural ponds 4. Pans and dams
5. Shallow wells 6. Boreholes

2.9 a. What is the household distance to the main source of water?.....

2.**9 b.** What is the livestock trekking distance to water sources?.....

3.0 How many 20 litre jerry cans of water does the household use per day? (domestic).....

4.(a) COPING STRATEGIES INDEX		
Consumption based coping strategies		
During the last 1 month were there days (and if so, how many) when your household had to use any of the following strategies to cope with lack of food or money to buy it		*(Write how many days for the last 7 days)* **(value - 0 to 7)**
4.1	Relied on less preferred and/or less expensive food	**[_____]**
4.2	Borrowed food, or relied on help from friends or relatives	**[_____]**
4.3	Reduced the number of meals eaten per day	**[_____]**
4.4	Reduced the portion size of meals	**[_____]**
4.5	Reduced the quantity of food consumed by adults/mothers to ensure that children had enough to eat	**[_____]**

	5.0 Food Consumption	**Number of days eaten in past 7 days If 0 days, do not specify the main source.**
5.1	Cereals and tubers: **Maize, Maize Porridge, Rice, sorghum, millet pasta, bread and other cereals, cassava, potatoes and sweet potatoes.**	**[_____]**
5.2	Pulses/nuts: **Beans, peas, groundnuts and cashew nuts**	**[_____]**
5.5	Meat and Fish: **Beef, goat, poultry, pork, eggs and fish**	**[_____]**
5.6	Milk: **Milk, Yoghurt and other diary**	**[_____]**
5.7	Sugar: **Sugar and sugar products**	**[_____]**
5.8	Oil: **Oils, fats and butter**	**[_____]**

	Question 6.0	
1.	In the past 30 days, was there ever no food of any kind to eat in your house because of lack of resources to get food?	0. Never (0 times) 1. Rarely/ Sometimes 2. Often (more than 10 times)
2.	In the past 30 days, did you or any household member go to sleep at night hungry because there was not enough food?	0. Never (0 times) 1. Rarely/ Sometimes 2. Often (more than 10 times)
3.	In the past 30 days, did you or any household member go to sleep at night hungry because there was not enough food?	0. Never (0 times) 1. Rarely/ Sometimes 2. Often (more than 10 times)

Question 7.0: During the last 12 months, was there a time when, because of lack of money or other resources:		
1.	You were worried you would not have enough food to eat?	1. Yes 2. N
2.	You were unable to eat healthy and nutritious food?	0. Yes 1. No
3.	You ate only a few kinds of foods?	
4.	You had to skip a meal?	1. es
5.	You ate less than you thought you should?	1. o
6.	Your household ran out of food?	1. es
7.	You were hungry but did not eat?	1. o
8.	You went without eating for a whole day?	1. es