

**SOCIAL-ECONOMIC DETERMINANTS OF HOUSEHOLD FOOD  
INSECURITY IN LUAPULA PROVINCE**

**BY**

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A dissertation submitted to the University of Zambia in partial fulfilment of the requirements for the Degree of Masters of Arts in Economics.

THE UNIVERSITY OF ZAMBIA

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## **DECLARATION**

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## **ABSTRACT**

This study investigated the incidence of food insecurity and its determinants among households in Luapula province, Zambia. The results are based on a household Living Condition Monetary Survey data of 2015. A random effect Logistic regression model was estimated based on this data with the household food security status (that is food secure and insecure) as the dependent variable and a set of demographic variables as explanatory variables. It was found that only about 35% percent of the households in Luapula are food secure, with the remaining 65% being food insecure. Further analysis identified household income, household size, own produce, education level, employment status, age and gender of the household head as important determinants of food security. While other variables of importance such as own produce, log of total income, region, education levels and employment status positively influenced food security, household size and household head being a domestic worker were negatively associated with household food security. The gender and age of the head of the household was not important in explaining the variation in household food insecurity status. Information provided by this study can be used as a reference source for policy decisions regarding household food insecurity in Zambia.

Key Words: Food Security; Determinants; Logistic Regression; Random Effect; Zambia

## **DEDICATION**

I would like to dedicate this paper to my father and mother (Mr. Cyprian Mwansa and Ivy Chisala) for the spiritual, moral and financial support rendered to me throughout my academic life. I will never forget your sacrifices as long as I live.

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## **ACRONYMS AND ABBREVIATIONS**

|      |   |
|------|---|
| IAPR | Indaba for Agricultural and Policy Research |
| CSO  | Central Statistics Office                   |
| LCMS | Living Condition Monetary Survey            |
| WB   | World Bank                                  |
| NFSP | National Fertilizer Support Program         |
| FAO  | Food Agency Organization                    |
| UNDP | United National Development Plan            |
| SDGs | Sustainable Development Goals               |

## **CHAPTER ONE**

### **INTRODUCTION AND BACKGROUND TO THE STUDY**

#### **1.1 Introduction**

This chapter covers the study background, statement of the problem, research objectives both the general and specific objectives coupled with research questions and finally a conclusion is provided. In the background are highlights of the impact of food insecurity in Zambia and the interventions being regarding the subject matter. The statement of the problem then indicates the need warranting this study using stated objectives to be achieved by answering, also stated, the research questions within a selected sample size.

#### **1.2 Background to the study**

The World Bank broadly defines food security as “access by all people at all times to enough food for an active, healthy life”. The term “access” here is inclusive of both the supply side (availability) and the demand side (entitlement). Defining food security at household level brings in further dimensions: “a household is food secure when it has access to the food needed for a healthy life for all its members (adequate in terms of quality, quantity, safety and cultural acceptability), and when it is not at undue risk of losing such access” (Saad, 1999).

food security exist only when all people at all times have physical, social and economic access to sufficient, safe and nutritious foods which meet their daily dietary needs and food preferences for a active and health life (WFP, 2015). This phenomenon has become a typical issue of discussion both locally and internationally. This has happened in the context of the Sustainable Development Goals (SDGs) on Poverty reduction and health indicators such as infant malnutrition, mortality and morbidity.

Ensuring household food security and consequently national food security is the aspiration of every government, Zambia inclusive. This could be achieved through various means among them domestic production, imports and strategic reserves. Due to the pressures of balance of payments and therefore demand for foreign exchange, developing nations put emphasis on domestic production of staple food to satisfy domestic demand in both national consumption and strategic reserves. Policy attention has thus focused on the improvement of rural household food security with a view of translating this into national food security and hence national growth (Maguswi, 2011).

Food insecurity lowers education attainment, especial for low income households. This leads to even lower incomes and higher unemployment rates. Without stable and long-lasting food security, there is likely to be continued negative effect on human capital and this will raise government fiscal costs, with negative consequences on government public spending. This also will lead to stagnated economic growth in the long term. Thus, food security is central to both short- and long-term economic growth (Torero, 2014).

According to JRC (2015), insuring food security in Sub-Saharan Africa (SSA) remains a huge challenge, and will continue to be so in the coming decades. FAO, IFAD and WFP (2015) estimate that over 200 million people in Africa are hungry. The share of undernourished people in SSA stood at 20.7% in 2010-2012. Moreover, given that by 2050 the population of SSA is expected to double (UNDP, 2015), feeding the poor will remain an enormous challenge. Not only will the demand for food continue to rise, but also the composition of food demand will change with rising incomes and growing urbanization contributing to changing diets (Popkin, 1994).

Zambia's food insecurity situation is evident despite the occasional surpluses the country produces during good crop years. Whichever measure of food security one uses, Zambia as a nation is facing food security challenges (Maguswi, 2011). As a result, chronic malnutrition (stunting) has affected about 45 to 47 percent of the rural households, whilst malnutrition (wasting) has inflicted about 6 percent of all rural households. In addition to this, only 59% of the population has access to safe water and this has serious negative implications on the health and nutrition status of the people (WB, 1994; WB, 1996). Therefore, the children affected with chronic malnutrition will remain physically and/mentally impaired for life, even if they survive. This high rate of malnutrition has serious implications on Zambia's development prospects.

The main sources of Zambia's food insecurity at household level are inability to produce enough food due to lack of agricultural service support and technical exigencies such as unfavorable climatic conditions, disease and insect attacks, etc; inadequate incomes and inability to purchase food; inadequate market and transport systems to take food from surplus to deficit areas within the country; and the impact of HIV/AIDs on the productive capacity of households. The detrimental impact that HIV/AIDS may have on rural households' productive capacity and food security has been experienced in some of Zambia's rural communities (Badari & Sulaiman, 2014).

According to Mutondo (2008), food security in Luapula province has been threatened by a number of factors. Some of the factors are the changing weather conditions (droughts, floods); population increase, the HIV/AIDS and the liberalization of the Zambian economy. These factors have contributed to the high levels of food insecurity and poverty in Zambia and Luapula province in

particular. In order to address the food insecurity and poverty problems the government came up with the Poverty Reduction Strategy Paper (PRSP). The social safety nets were put in place to cushion the rural people such as the National Fertilizer Support Programme (NFSP) and the contracting of the Programme Against Malnutrition (PAM) to execute the Food Security Pack (FSP).

Programme Against Malnutrition-Food Security Pack (PAM-FSP) has been in operation for almost eighteen agricultural seasons since the inception in 2000-1 season. The goal of the Food Security Pack (FSP) was to reduce poverty among the vulnerable but viable farmers through improved household food security. To achieve this goal, four programme components were designed including:

- 1) Diversification and conservation farming;
- 2) Market entrepreneurship and Cereal/seed Banks development.
- 3) Alternative livelihood interventions;
- 4) Programme management and co-ordination.

PAM executed the food security pack in Luapula province to address the food insecurity and poverty problems. In 2003, Farming Systems Association of Zambia (FASAZ) on behalf of PAM carried out the Mid-Term Evaluation. The evaluation was carried out to assess the programme efforts, effects, change and impact of the food security pack on the target vulnerable but viable farmers. The findings by Mutondo (2008) were that:

1. Analysis of two implemented components the Food diversification and Cereal/Seed bank showed that the components achieved modest impact on the livelihood of the vulnerable but viable farmers.
2. The components demonstrated limited identifiable impact in the field in terms of increasing beneficiaries' access to inputs i.e. seed and fertilizers.
3. The components demonstrated limited identifiable impact in the field in terms of increasing food security both at households and community level.
4. Impact at the national level was minimal.

The impact or effects of food insecurity are dire. Food insecurity represents a major key factor under laying the cause of malnutrition, death and disease. Thus it makes a very interesting area of research. Despite ample food production and large food surpluses during the years of better harvest, rural farmers always remain the most vulnerable to food insecurity. It is believed that the inability of small-scale farmers to retain enough food stocks reflects the inadequate levels of production by poor households and the poor storage capacity and food distribution systems. (Maguswi, 2011).

For most rural households in Zambia, the cultivation of maize provides their primary source of income, as well as food. As a crop, maize is particularly vulnerable to drought, and increasingly erratic and lower rainfall has had a severe impact on maize production in Southern Zambia. At the same time, economic structural adjustment has resulted in a withdrawal of state support for producers. This has made adjusting to climatic change more difficult, while introducing the additional burden of having to adapt to new market conditions as state marketing boards and cooperatives have been replaced with private traders and the uncertainties of free markets (Murray and Mwendwe, 2005).

Studies have been conducted in Luapula in relation to malnutrition. Bultemeier et.al (2001) stated that high rates of chronic and acute malnutrition in Luapula valley were the starting point for the IHFSAN project. They identified the major causes of malnutrition in Luapula valley to be: i) household food insecurity; ii) poor health, water and sanitation; iii) Poor knowledge base; and iv) Inadequate care for the nutritionally vulnerable. This analysis was confirmed by a participatory rural appraisal carried out by FAO.



### **1.3 Statement Of the Research Problem**

Food insecurity is one of the most worrying issues and among the most challenging socio-economic problems for many countries in the world today, particularly developing economies (Mustapha, 2016). At continental level, about 27.4% (and rising) of the people in Africa are said to be chronically undernourished (FAO, IFAD, WFP, 2015).

In Zambia, although food insecurity varies from household to household about 82% of the population in rural parts of the country are said to be vulnerable to food insecurity (MoFN; 2006). As a consequence of food insecurity, about 47% of children are stunted and 28% are underweight, while 5% are still wasted (MoFN; 2006).

Also, vulnerability to food insecurity represents a major developmental challenge for Zambia, for several reasons. Firstly, Adults in food insecure households have poorer self-rated health, poorer mental and physical health, poorer oral health, greater stress, and are more likely to suffer from chronic conditions such as diabetes, hypertension, mood and anxiety disorders. Households faced with poor health will produce less as a result of time and energy spent in their fields (Fink and Masiye, 2015). This situation ultimately lead to low food productivity.

Food insecurity also makes it difficult to manage existing chronic conditions such as diabetes and HIV. For example, food insecure individuals with HIV (an infection that is associated with increased energy and protein needs) are critically constrained in their ability to control the quality and quantity of food they consume.

It can be argued that the rural households in Zambia are mostly hit by food insecurity relative to urban households, since out of the 65% total population living in rural areas; only 41% of total income is credited to them (LCMS, 2015). Besides rural areas, food insecurity is eminent among the poor households. Luapula is one of the poorest provinces in Zambia with 67.7% of its population

living in extreme poverty (LCMS, 2015). The high levels of chronic malnutrition (43% according to IAPRI; 2015) are some of the consequences of food insecurity.

In view of the consequences of food insecurity in luapula, there have been attempts at combating food poverty, malnutrition and household food insecurity. However, despite all the major interventions, such as the Farmer Input Support Program (FSP), Program against Malnutrition (PAM), and Poverty reduction programs (PRS), the problem of food insecurity remains high.

The problem is that while a lot of attention has been given to the consequences of food insecurity in luapula, little is known about the positive/negative contribution that household social-economic factors pose to food insecurity in Luapula Province. Mutondo (2008) established that food insecurity in Luapula province has been threatened by a number of factors. Some of the factors are the changing weather conditions (droughts, floods); population increase, the HIV/AIDS, varying household incomes and growing demand for food. However, apart from income, his paper did not look at the social-economic factors influencing food insecurity.

The current study fills the knowledge gap by establishing the extent of food insecurity and magnitude of its social-economic determinants in rural Luapula province. This also contributes to board of knowledge on the various factors driving food insecurity.

#### **1.4 Objectives of the Study**

This paper investigated the incidence and household determinants of food insecurity in luapula province

The Main objective of this study was to investigate the determinants of household vulnerability to food insecurity in a rural province of Zambia.

#### **Specific objectives:**

The study set out to achieve three specific objectives:

1. To establish the incidence of food insecurity in luapula province.
2. To assess the relative importance of determinants of food insecurity in Luapula Province.
3. To suggest some of the policies needed to improve food insecurity

### **1.5 Research Questions**

1. How much food insecure are the households in luapula province?
2. To what extent do the determinants affect food insecurity in Luapula Province?
3. What Policies should be used to reduce or reverse the situation of food insecurity in Luapula Province?

### **1.6 Significance of the study**

This study is important to various stakeholder. Firstly policy makers will benefit from the findings of this study as they seek to come up with province specific policies that impact the livelihoods of people. Non-Governmental Organizations will also benefit from this study as it provides the basis for them in their quest to improve the welfare of the rural households. The findings of this study will also help government come up with interventions to address the factors causing food insecurity and not the consequences of food insecurity.

### **1.7 Research Hypotheses**

This section highlights the key hypotheses for this study which are deemed to be of significance to food security status of a household, in luapula province. The following hypotheses (Null) have been tested in this present study:

- i. Household social-economic factors (i.e. education level, total income, and household size, age of head of household, gender and employment status) do not affect the food insecurity status of a household.
- ii. Food insecurity is not affected by geographical location factors such as residence (Rural and urban).

## **1.8 Organization of the dissertation**

The rest of the study is organized as follows: Chapter 2 presents the theoretical and empirical literature review, Chapter 3 presents the methodology used in the study. Results are then presented in Chapter 4 before the discussion is given in Chapter 5. Chapter six presents conclusions and policy recommendations based on the findings of this study.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter discusses both the theoretical and empirical literature. The conceptual framework is also presented in this chapter. This is in order to show rigor, intuition and critical appraisal in light of the broader literature.

#### 2.2 Theoretical Framework

The theoretical framework for modeling food security is, in general, built within the framework of household utility model. Following the work of Singh et al. (1986), recognition is made that some households are both consumers and producers of their food and thus, model household utility within the framework of consumer demand and production theories as follows:

$$U_i = u(C_i; l_i/x_i).$$

where  $U_i$  is a utility function that is twice differentiable, increasing in its arguments, and strictly quasi-concave;  $C_i$  is a vector of the  $i^{\text{th}}$  household's consumption demand, which include food  $C_f$ , and non-food  $C_{nf}$ ;  $l_i$  is the time devoted to leisure and  $x_i$  is the vector of household socio-demographic variables that we include, in order to recognize that household utility is derive from the combination of decisions made by household members according to their preferences. Given the foregoing definition of  $C_i$ , it can be specified as:  $C_i = (C_f ; C_{nf})$ .

As some households are both consumers and producers of food,  $C_f$  can be further considered as a vector of home-produced food  $f_{hp}$  and  $f_{mp}$  and market-purchased food  $f_{mp}$ . Again, within this context,  $C_f$  can be stated as follows:

$$C_f = (f_{hp}; f_{mp})$$

This theory is relevant to this study because it links well household utility model and determinants of household food insecurity. The household utility maximization model has also been used by many researchers (such as Amaza (2006), Muktar (2013) and Mustapha (2016)) to relate food insecurity to its determinants. This paper adopts the theory as it models household utility by including  $x_i$  which is the vector of household socio-demographic variables this paper seeks to establish in its argument.

### **2.3 Conceptual framework**

The conceptual framework used in this study is based on Research Triangle institute (RTI) (2014) and Babu, et.al (2017). This framework has been adopted and modified to include other social economic characteristics that have been hypothesized to influence food insecurity in luapula Province. According to RTI (2014), although the definitions of food security and food insecurity may be simple, the determinants and the relationships among determinants of food security are not. Outcomes related to food security status for a given household are influenced by a complex tapestry of “risk factors” (i.e., factors, internal or external, that make a household more or less food insecure). This tapestry includes; Social, economic, environmental, and political domains; Community partners and businesses. This framework is chosen has it links well an individual household to its social economic factors, the link between a household and its social economic determinants is of paramount importance to this study.

Figure 1 shows the interconnectedness between the household and its factors. It is important to note that the luapula households have been subjected to policy programs as given by the figure below. The inclusion of components such as nation, state and local reiterates the fact that food insecurity is a challenge at any level of society.

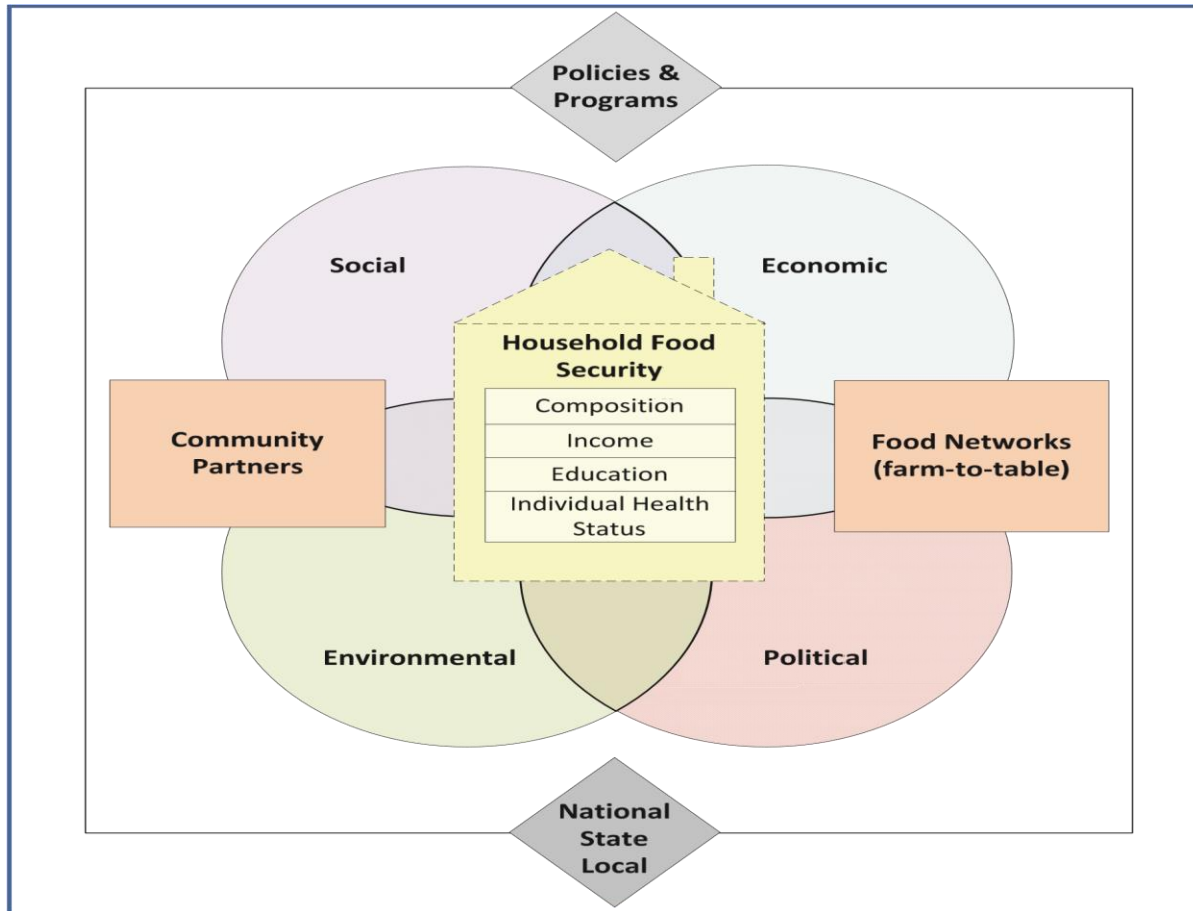


Figure 1. The complex tapestry of food insecurity.

Source: Adapted from (RTI, 2014).

Figure 1 above shows the food networks that process and distribute food. It also shows Household characteristics that include composition (e.g., number of children), income level, education, race and ethnicity, and health status of individuals (e.g., disabled). This also includes other characteristics such as gender, own produce and employment status. Integral components of this complex tapestry include local, state, and policies/programs like PAM, PRS and FPS that have been developed to provide nutrition assistance to households in Luapula Province. Throughout this study, research on these factors and, to the

extent possible, the association between these determinants and food insecurity are described.

Babu, et.al (2017) also adds that highly productive labor force, in an economy that produces adequate employment opportunities, should contribute to reduced poverty which further can result in reduction in food insecurity (hunger) and under-nutrition, which can improve the health status and along with other variables can increase labor productivity.

From the educationists' point of view, the level of education is a significant determinant of food insecurity as it leads to improved cognitive abilities, enhanced household income generation and food production possibilities. Meanwhile, development economists are more concerned with poverty reduction measures (Babu, et al., 2017).

## **2.4 Empirical literature**

This section highlights studies that have been done about household food insecurity (security). The focus of this section is to synthesis and summarize the empirical works done by other scholars with more emphasis on the measurement of food insecurity, determinants and the methodologies used to obtain the results.

## **2.5 Measurements of food insecurity**

Food insecurity is a complex phenomenon attributable to a range of temporally and spatially varying factors, such as the socio-economic and political environment. The literature reviewed has shown that there is no unifying measure of food insecurity. Due to this fact, different scholars have used and justified the use of different methods to measure food insecurity. This paper hoped to contribute to the on-going academic debate about the best measures of food insecurity by carefully assessing the different methodologies and applying one that best suites the study. Therefore, it is imperative that the different measures of food insecurity are discussed.



There are five commonly used methods that can be used to assess food insecurity each with different applications, advantages and disadvantages; i) the Food and Agriculture Organization (FAO) method for estimating calories available per capita at the national level; ii) household income and expenditure surveys; iii) individual's dietary intake; iv) anthropometry; and v) experience-based food insecurity measurement scales.

### **The FAO method**

As developed by the Food and Agriculture Organization, this method estimates calories per capita at the country level using Food Balance Sheets and energy intake variance data derived from household income and expenditure surveys (Pérez & Segall, 2008) and (Fawole, 2015).

Countries need the following information to be able to apply this method: i) total calories available in year of interest; ii) number of people living in country in year of interest; iii) coefficient of variation of caloric intake to generate the energy intake distribution curve; iv) cut-off point to estimate the proportion of the population falling under the minimum per capita average caloric requirement.

The per caput DES (Dietary Energy Supply) refers to food acquired by households rather than the actual food intake of individual household members (Naiken, 2002) and it therefore does not show the inequitable distribution of available supplies within countries. This method may overstate prevalence of undernourishment in some regions and understate it in others by placing too much stress on mean energy consumption and not enough on energy distribution (FIVIMS, 2002).

### **Qualitative method**

The qualitative method of assessing food security examines people's perceptions about energy inadequacy and food deprivation and provides a simple, direct measure of food insecurity and hunger that is country- and context-specific (Kennedy, 2002). The method targets those who have experienced food insecure

conditions directly and examines experiential dimensions including emotional effects and behavioral changes (FIVIMS, 2002). Interviewers look for evidence of an alteration in food type consumption through substitution for cheaper foods, the physical sensation of hunger or weight loss, the experience of running out of food without money to obtain more and the perception that consumed food was inadequate in quality or quantity (Bickel *et al.*, 2000).

### **Individual's dietary intake**

Pérez and Segall (2008) noted that the individual's dietary intake can be measured through different methods including: i) 24-hour recall; ii) food frequency questionnaires; iii) food records kept by individuals or by an observer. All dietary intake methods need to make use of a reference time frame. Whereas some of the methods rely on the memory of participants (24-hour recall, food frequency questionnaire), others rely on the recording of foods, as they are consumed, by the study participant, a proxy or an observer. Lastly, to interpret the nutrient intake findings it is important to have cut-off points for determining the proportion of the sample or population at risk of deficiencies for different nutrients.

Dietary diversity score (DDS) measures the degree to which the variety of food consumed by households differs in terms of nutrient intakes over a given period of time. The DDS suggest that households gain satisfaction on food consumed not only because “more is better”, but because “variety, which DDS represents, is the spice of life” (Ogundari, 2017).

Some studies have however ,shown that fat and carbohydrate intakes are under-reported to a larger extent than protein (FIVIMS, 2002), while fish and other non-staple foods consumed in small quantities may be missed in surveys, leading to an underestimate of levels of micronutrient intake (Mason, 2002). Indeed under-reporting is common in dietary assessment surveys causing a potentially significant source of error.

## **Anthropometry**

Anthropometry is defined as the measurement of size, weight, body proportions and ultimately the composition of the human body. Anthropometric indicators measure the impact of both food insecurity and health status on the nutritional status of individuals. The anthropometric indicators most commonly used in national surveys are based on weight and height (or length) of infants, young children, youth and adults. The interpretation of the adequacy of the anthropometric indicators is based on well-established cut-off points.

There are two main limitations when using anthropometric indicators as proxies for food insecurity. First, these indicators are an indirect approximation to food insecurity, as they measure nutritional status which is the result of the interaction between food (in)-security and health status. Second, the interpretation of the relationship between food insecurity and obesity is complex, as there is growing evidence that whereas severe food insecurity leads to wasting, mild to moderate food insecurity may lead to obesity. Individuals in this food insecurity category may rely heavily on cheap high-energy low nutrient density foods (Pérez & Segall, 2008)

## **Household income and expenditure surveys**

This method is based on interviewing respondents in their households. Respondents provide information on the amount of money that they spend on food and other necessities. Different time reference periods have been used including the week(s) or month(s) preceding the survey. The following inputs are needed to be able to take full advantage of this method: i) quantity of food bought (or expenditures) and costs associated with different foods consumed within and outside the house; ii) foods received by any household member as either a gift or as payment for work, goods or services; iii) foods grown for consumption by household members. This method estimates calories consumed on average per household member per day (Pérez & Segall, 2008).

Food insecurity is increasingly concentrated in particular regions or groups within countries and thus there is a great need for sub-national information (Cunningham, 2005). Household income and expenditure surveys (HIES) obtain information on a variety of specific conditions, experiences and behaviors indicating the severity of the condition (FIVIMS, 2002).

The use of per capita food expenditure as an indicator of food security has been widespread (Ogundari, 2017). It is often used in measuring food accessibility (Smith and Subandoro 2007; Faridi and Wadood 2010). While Hendriks and Msaki (2009) argue that expenditure on food reflects both the concepts of food accessibility and to some extent, the degree of vulnerability to food insecurity. Faridi and Wadood (2010) suggest that higher expenditure proportions are only essential indicators of inter-temporal vulnerability to food insecurity. As a result, food expenditure proxies' food accessibility dimension of food security because food prices and household resources affect the extent to which households have economic access to food. Expenditure on food does not provide any information on the nutritional quantity that household consume, but rather, it reflects the extent to which households' resources affect the amount of food consumed.

The present study employed the expenditure method to model household food insecurity for Luapula province as it was not only consistent with the reviewed literature, but also the data on Luapula Province.

## **2.6 Incidence of food insecurity in rural Africa**

Since 1990-92, other sub-regions experienced an increase in the absolute number of undernourished people, approximately 20 percent and 2 percent respectively in Eastern and Southern Africa. Middle Africa has more than doubled its number of undernourished people over the same period, largely due to civil strife and insecurity. Much of Eastern Africa has also been affected by unfavorable climatic and drought conditions, particularly in the Horn of Africa. These factors seriously undermined progress toward improving food security and nutrition.

In line with the 2015 deadline set for achieving the Millennium Development Goal targets, Sub-Saharan Africa (SSA) made some progress towards halving the proportion of its population suffering from hunger (MDG 1.C target). Overall, the prevalence of hunger in the region declined by 31 percent between the base period (1990-92) and 2015, according to the latest estimates of the State of Food Insecurity in the World (SOFI 2015 report). In other words, approximately one person out of four in SSA is estimated to be undernourished today compared to a ratio of one out of three in 1990-92.

The number of poor people in Sub-Saharan Africa, living with less than \$ 1.25 a day, has declined by 23 percent between 1993 and 2011 (World Bank, 2015). This improvement follows a global poverty reduction trend of 59 percent during the same period. Many countries are on course to meet the goal of halving the proportion of people living with less than \$ 1.25 a day, between 1990 and 2015 (MDG.1A target).

Specifically, poverty rates have decreased in most countries in the region, mainly in those countries that have increased food availability as well as experienced economic growth. For example, South Africa has drastically reduced poverty rates from 26 percent in 2000 to 9 percent in 2011, exhibiting a 64 percent decline. Niger reduced its poverty rates by 48 percent from 1994 to 2011 while Ethiopia recorded 33 percent decline from 1999 to 2010. In Rwanda the poverty rate declined by 21 percent from 2000 to 2011 and in Mali the decline was 17 percent from 2001 to 2010 (World Bank, 2015).

## **2.7 Determinants of food Insecurity: Developed Country Perspective**

There has been quite vast research documenting the major determinants of household food security in both developed and developing countries. Measurable variables have been formulated to reflect the determinants of Household food security by considering a combination of characteristics such as, age, gender, Per capita expenditure, education, marital status, own produce, family size, region, employment and total incomes of the households.

Different studies have identified different factors affecting food security, this paper sort out to review literature that used logit or probit models (multinomial or binary) in linking food security to its determinants.

In developed countries, food security has been modelled with emphasis on the factors that influence it. For example, Rose (1999) reviewed data on the economic determinants and dietary consequences of food insecurity and hunger in the United States. He noted that Income is clearly one of the most important determinant of food insecurity and hunger. Evidence from the 1995 Current Population Survey (CPS) showed that 17% of households with incomes, 50% of the poverty level were affected by some form of hunger, whereas the rate falls to 1.4% for those with incomes .185% of the poverty level.

Another study was done in a developed country, Canada. Tarasuk and Vogt (2009) used Logistic regression to identify the socio-demographic characteristics of households most likely to report food insecurity. They found that three potent socio-demographic correlates of household food insecurity were very eminent in Ontario: low income adequacy, social assistance as the main source of income, and not owning one's dwelling. These three variables have been repeatedly associated with increased odds of food insecurity.

Caillavet et al. (2011) focused on food security amongst French adults, and concluded that food security is higher in middle-aged individuals, if the individual has higher levels of education and income, if the individual owns a house, or if the individual is currently a smoker. Méjean et al. (2005), also in France, found that the debt of a household is negatively correlated with the status of food security of the individuals living in it.

Food insecurity is also a problem in countries like Portugal. Álvares (2013) using data from the National Health Survey wave 2005/06, concludes that 17% of the population was food insecure, and 3.7% were in a state of severe food insecurity. The factors associated with the presence of food insecurity were being a female,

being younger, having a lower education level, having smoking habits and a lower self-evaluated health status. Also in Portugal, The General Directorate for Health (DGS) of the Portuguese Government (2013) reports that 32.1%, 8.1% and 8.8% were respectively mildly, moderately and severely food insecure. The likelihood of being food insecure increases with living in Algarve, being illiterate, being over 65 years of age or living in a household with people over 65, being unemployed or a stay-at-home worker and poor health. Conversely, secondary or post-secondary education and if the individual is living in a household with more than 4 people increases food insecurity.

Another study by Sequeira (2016) also found that Age, equalized income, being employed, having more education, being an immigrant,<sup>48</sup> and producing goods for own-consumption have a positive impact on food security. Being in a single adult household, being unemployed, being male, being poor and having a higher burden of debt negatively impact food security. The production of goods for own-consumption in home gardens is found to have a positive causal relationship with the food security of the individual. Being poor increased this positive relationship.

## **2.8 Food insecurity in Developing countries: Rural and urban debate**

There is an ongoing debate regarding food insecurity in developing countries. This is due to the growing demand for more research to be directed to urban food insecurity challenges.

Some researchers have argued for urban food insecurity as the challenge that needs more attention. Jonathan (2013) notes that the new global and African food security agenda is overwhelmingly productionist and rural in its orientation, and is based on the premise that food insecurity is primarily a rural problem requiring a massive increase in smallholder production. This agenda is proceeding despite overwhelming evidence of rapid urbanization and the growing likelihood of an urban future for the majority of Africans. Urban food insecurity can therefore no longer be ignored. He argues that achieving urban food security

is the emerging development challenge for the 21st century and that the complexities of urban food systems urgently need to be addressed by researchers, policy makers, and international donors and multilateral agencies.

Crush (2010) also postulates that in a continent undergoing rapid urbanization, with an increasingly greater proportion of the population looking to the towns and cities for their livelihood, the issue of urban food security has been curiously neglected. While the food security of urban populations obviously cannot be divorced from rural agricultural production, the relationship is far from simple. Many urbanites, even the very poorest, do not buy their food from small farmers within the boundaries of their own country.

Large commercial farms are integral to urban food supply chains in many African countries, as are food imports from within and outside the region. Urban agriculture, in which the urban poor produce their own food, is sometimes advocated as the “key” to greater urban food security. But urban food security is much more than an issue of backyard gardens or rural-urban food transfers.

While the hypothesis that urban food insecurity is a challenge holds, there is enough, convincing evidence that rural poverty is Just as important if not more important. Welderufael (2014) studied food insecurity in Ethiopia, and concluded that it is more pervasive in rural areas. Harris-Fry et al. (2015) established that wealth and literacy are associated with improved food security, as well as the dietary diversity in women living in rural Bangladesh.

Mustapha (2016) extended the study on food insecurity by examining the relative occurrence of the wide categories namely mild/Very low, moderate and severe food insecurity using ordered probit model and analyzing data from 4,288 households in northern Ghana. The study shows that for each of these categories, households’ rural dwelling, age, land size and access to credit significantly increase food insecurity whilst maize crop output and marital status



decrease food insecurity. This study reveals that food insecurity is a rural and productivity problem and not a poverty issue (or inadequate credit).

In a quest to capture the multidimensional nature of food security, Ogundari (2017) uses a novel ideal that harmonizes two food security indicators (food expenditure (FOODexp) and dietary diversity score (DDS)) to categorize households into different levels of food security states in Nigeria. In addition, the study also examined factors that influence the probability of households being in different levels of food security states in the country. The empirical results show that households that consume only home produced food have high probabilities of being food insecure, while households that consume only market-purchased food are less likely to be food insecure. This implies that the households in rural areas with limited or no access to markets are more likely to be food insecure than the urban households.

Omotesho et.al (2005) conducted a study in Nigeria to identify the determinants of food insecurity situation in Nigeria, the study shows that one third of the sampled rural households were food insecure. The authors considered annual gross farm income, household size, annual non-farm income of households and total farm size in hectares as determinants of food insecurity. The study revealed that farm size, gross farm income and household size were the major determinants of food insecurity among the sampled households.

In another study conducted by Sunusi (2006), the determinants of food insecurity identified included but not limited to household incomes, level of education of households, and the household size. The study revealed that about 70% of the sampled rural households were food insecure.

In Zambia, a few studies have been done regarding food insecurity. The Zambian literature is equally without controversy regarding food insecurity being a rural or urban phenomenon. Mulenga (2011) observed that there exists a strong relationship between levels of household income and food insecurity. Income

usually has a strong bearing on the food security of urban households, particularly because they depend almost entirely on markets for their food supply. He argued that even within poor communities, higher-income households had better access to food, higher household dietary diversity and more months of adequate household food provisioning. Similarly, middle-income households had better access to food, higher household dietary diversity and more months of adequate household food provisioning than the lowest income households.

He concluded that food insecurity was no longer a rural phenomenon but also an urban one as it was evidence from his study of Lusaka district that showed food insecurity using four different scales namely; household food insecurity access scale, household food access prevalence indicator, household dietary diversity scale and Month of adequate food provisioning. Contrary to the findings of Mulenga (2011), which emphasized not only on food insecurity in urban areas, but also income as the major determinant of food insecurity, Magusuwi's (2011) study on Small holder farmer in Chibombo established that most of the households that experienced food insecurity lacked adequate production assets. His probit model results also showed that education level of household head, off farm activities, cooperation in acquiring inputs, and accesses to storage chemicals, number of hectares owned, sex of household head and distance from the farm to the nearest surface road were insignificant in explaining food insecurity in Chibombo district. However, the output showed that a one year increase in the household farming experience would increase the probability of food security by 3%. This means that farming experience not age of the farmer could improve household food security. An increase in household membership by one person with working capabilities (an adult) would increase the probability of food security by 5%. A percentage increase in input support to the farm would increase the probability of food security by 2%. Furthermore it was found that, holding other variables constant, a percentage increase in household production assets would increase the probability of food security by about 0.7%.

## **2.9 Summary of Literature review**

This chapter has reviewed the literature relevant to the study. The study starts by looking at the household utility maximization theory as postulated by Singh et al. (1986) before discussing a complex tapestry of determinants of food security. Further the empirical review of literature deals primarily with the different methods used to measure food security as well as the debate surrounding food insecurity. This is in order to participate in the ongoing academic discussion regarding this subject matter.

In the nutshell, these empirical studies show clearly that variables like head of the household education attainment, age of head of household, income of household head and other factors affect food security of households. However, their impact is not uniform among studies. Some studies show positive, significant relationship, others show a negative significant effect .while other factors have shown insignificant relationship to food security.

Another gap identified in literature and more specific to Zambia is that most studies reviewed (apart from Mulenga (2011)) focused on food insecurity in relation to agricultural households. This leaves out households that did not engage into agriculture and are potentially more affected by food insecurity. Additionally, and more importantly, the current study contributes to the board of knowledge on the social economic factors that influence food insecurity in rural areas. To the best of knowledge of the researcher, this paper is the first of its kind in luapula province and may serve as the references paper to other researchers seeking to understand the dynamics of food insecurity in luapula Province and Zambia as a whole.

## CHAPTER THREE

### RESEARCH METHODOLOGY

#### 3.1 Introduction

This chapter outlines the methods that were used to achieve the study objectives. It considered the research design, sources of data, model specification, method of collection and the techniques used in the analysis of the data.

#### 3.2 Variable Description

**Food Security**-While food security has many dimensions, this paper adopts the money matrix measure of food security. Food security therefore is defined as the access to enough food to eat by all household members at all times for healthy and active life. Access is determined through means to procure food through production, purchases, gifts or exchanges. Food secure households should not be at risk of losing access to food, which should be acquired in socially acceptable ways without resorting to emergency food supplies, scavenging, stealing or other coping strategies (FIVIMS, 2003). Purchasing power is therefore essential to guarantee access to sufficient food at the household level (World Bank, 1986; Clover, 2003). Scholars like Kanyangwa (1995), argued that the definition of food security has nutritional implications. According to the Kanyangwa (1995), food security can be proxied by food poverty. Poverty has defined by the World Bank's poverty assessment of Zambia has household food security implications and is based on the cost of a minimum food basket.

The food basket contains all the foods eaten by an average Zambian that meets nutritional requirements of household members. Poverty is defined as expenditure less than the cost of food basket to which 30% of non-food expense is added (World Bank, 1994). Hence poverty has defined by the World Bank is a good proxy for households' food security. However, such proxies have been

criticized in recent literatures as poverty cannot proxy food security which is multidimensional in nature.

This study uses food per capita expenditure as a measure of food security. The use of per capita food expenditure (FOODexp) as an indicator of food security has been widespread. It is often used in measuring food accessibility (Smith and Subandoro 2007; Faridi and Wadood 2010).

Similar to the work of Canagarajah and Thomas (2001) and Omonona and Adetokunbo (2007) and recently Ogundari (2017), this study uses the weighted two thirds of the mean of per capita expenditure (Average per capita monthly food expenditure denotes the average monthly food expenditure of a household member. It is calculated as a quotient of total household monthly food expenditure and the total number of persons in the household) as a threshold so that a household is referred to as food secure (or food insecure) when the observed per capita food expenditure is greater (or less) than the threshold.

**Independent variables** included in the model are Household size (measured as a continuous variable), a dummy variable for education levels of the household head (maximum education level). Gender of the head of the household, age of the household head will also be included in the model as suggested by Mwenjeri et.al (2016). Marital status, gender, household size, employment status of the head of the household, region (rural/urban) and log of total income are other demographic variables to be incorporated in the model. Age of the household is an indicator of the household life cycle while education indicates the level of understanding of nutritional importance by the household head. The type of employment the head of the house is involved in is also vital in determining the food security status of that household. Apart from the said variables, a community level variable called PSU is included in the estimation to control for community level factors.

### **3.1 Data Collection**

The research was based on cross sectional secondary data from Central Statistics Office. Specifically data was collected from the latest Household Living Conditions Monetary survey data of 2015. The LCMS is a population-based, household survey that collects data using structured personal interviews with household members. The main objective of the LCMS is to measure the wellbeing of the Zambian population, and to provide trends in the different measures of societal wellbeing over time. The 2015 LCMS was designed to provide estimates at national, rural/urban and province. Survey estimates were also disaggregated by age, sex and socio-economic strata.

The survey collected information on the following areas of population wellbeing: general living conditions (including household size, composition and relationships; household incomes and expenditures; food production, and coping strategies), economic activity and employment status of household members, education level of household members, health status of household members (including child nutrition; incidence of ill health and injury; household deaths and cause of death), housing conditions (including type of housing; access to water and sanitation; and access to electricity), as well as access to community level socioeconomic facilities such as health facilities, schools, banks and transport (LCMS report,2015).

### **3.3 Sampling**

The sampling frame used for the 2015 LCMS was developed from the 2010 Census of Population and Housing. The 2015 survey was designed to cover a representative sample of 12,260 non-institutionalized private households residing in both rural and urban parts of the country. A total of 664 Enumeration Areas (EAs) were drawn from a total of 25,600 EAs nationwide. The survey was designed to produce reliable estimates at national, provincial and Residence (rural/urban) levels. The country is administratively demarcated into 10 provinces, which are further divided into districts. The districts are further

subdivided into constituencies, which are in turn divided into wards. For the purposes of conducting household based surveys, wards are further divided into Census Supervisory Areas (CSAs), which are subsequently subdivided into Enumeration Areas (EAs). The EAs constituted the Primary Sampling Units (PSUs) for the survey.

The 2015 survey employed a two-stage stratified cluster sample design. During the first stage, 664 EAs were selected with Probability Proportional to Estimated Size (PPES) within the respective strata. The measure of size used was population figures taken from the frame developed from the 2010 Census of Population and Housing. During the survey, listing of all the households in the selected EAs was done before a sample of households to be interviewed was drawn. In the case of rural EAs, households were listed and stratified according to the scale of their agricultural activity. Therefore, there were four explicit strata created at the second sampling stage in each rural Enumeration Area (EA).

### **3.4 Research Design**

This research employed a cross-sectional design to measure the association between food insecurity and household social economic food characteristics in Luapula province.

### **3.5 Data Management and Analysis**

The study used Stata software version 14 to analyse the data. Data cleaning was also done using Stata. Several diagnostic tests were performed in order to take into account possible biases during data analysis. These tests included specification, goodness-of-fit, linearity diagnostics and test for suitability of random effects or fixed effects.

### **3.6 Estimation**

#### **3.6.1 Model Estimation procedure**

It is assumed that variations in food security are attributable to individual and community (geographical) level factors. In this study, individual level factors

were modelled to include household characteristics. Household characteristics included only income of head of household, household size, level of education of head of the household, gender of head of the household, employment status and region. On the other hand, only a variable called PSU which is a concatenation of district and cluster is included in the model to control for community factors. Using a mixed logistic regression framework, variations at community level were captured as random effects while those at individual level were captured as fixed effects. In multilevel models, one or more parameters are modelled as 'random', being drawn from a distribution. It is about estimating the main model and the random parameters simultaneously.

To estimate the mixed logistic model, CSO's Living Condition Monetary Survey cross sectional data for the year 2015 was used. According to Cameron and Trivedi, Discrete outcome or qualitative response models are models for a dependent variable that indicates in which one of  $m$  mutually exclusive categories the outcome of interest falls. Often there is no natural ordering of the categories. For example, categorization may be on the occupation of a worker.

Binary outcomes are simple to model and estimation is usually by maximum likelihood because the distribution of the data is necessarily defined by the Bernoulli model. If the probability of one outcome equals  $p$ , then the probability of the other outcome must be  $(1 - p)$ . For regression applications the probability  $p$  will vary across individuals as a function of regressors. The two standard binary outcome models, the logit and the probit models, specify different functional forms for this probability as a function of regressors. The difference between these estimators is qualitatively similar to use of different functional forms for the conditional mean in least-squares regression (Cameron & Trivedi, 2005).

An OLS regression of  $y_i$  on  $x_i$  ignores the discreteness of the dependent variable and does not constrain predicted probabilities to be between zero and one. A more appropriate model is the logit model. The Food security empirical model



was estimated using logistic regression which relies on maximum likelihood estimation. An xtlogit technique in Stata was used to measure the likelihood of Food security demand conditional on a number of covariates. This is an iterative approach where various solutions are estimated until the best solution of having the maximum likelihood is found. The model is then specified as below;

$p_i = \Pr[y_i = 1 | x_i] = \frac{\exp(\beta_1 + \beta_2 x_i)}{1 + \exp(\beta_1 + \beta_2 x_i)}$  and clearly ensures that  $0 < p_i < 1$  (Cameron & Trivedi, 2005).

$Y_i$  is the observe response for  $i^{\text{th}}$  observation (i.e. binary variable,  $Y_i = 0$  for food secure households and  $Y_i = 1$  for food insecure households).  $I_i$  is an underlying unobserved stimulus index for the  $i^{\text{th}}$  observation (conceptually for each household; if  $I_i < I_i^*$  the household is observed to be food secure if  $I_i \geq I_i^*$  the household is observed to be food insecure

Logit estimation is used in this study due to its relative simplicity. Gujarati (2002) observed that in practice many researchers choose the Logit model over probit models because of its comparative mathematical simplicity. While the question of which model to use in binary choice analysis is unresolved, it has been observed that in most applications, it does not make much difference since the models give similar results.

### **3.6.2. Mixed Logistic regression estimations (XT Logit)**

In order to determine the influence of the independent variables on the food insecurity of households in mansa, a mixed logistic regression analysis was conducted. It seems likely that heads of the households within a cluster (Primary Sampling Unit) will be more similar to each other than the heads of the households in other Clusters due to various reasons. Household level characteristics are measured by standardized measures. Additionally, unmeasured characteristics such as the cluster level characteristic (Presence of school in that cluster, poor water and sanitation etc.) can highly raise or lower the chances of a given household being either food secure or insecure.

In such a case as described above, mixed logit models (Fixed and random effect) are used to model such data. Wooldridge (2002) noted that generally, fixed and random effects methods can be applied to a cluster samples. These are cross sectional data sets with each observation belonging to a well-defined cluster.

There are two common assumptions made about the individual specific effect, the random effects assumption and the fixed effects assumption. The random effects assumption (made in a random effects model) is that the individual-specific effects are uncorrelated with the independent variables. The fixed effect assumption is that the individual-specific effects are correlated with the independent variables. If the random effects assumption holds, the random effects model is more efficient than the fixed effects model (Train, 1998). However, if this assumption does not hold, the random effects model is not consistent. Therefore before analyzing the regression coefficients, two models were analyzed and tested for appropriateness. The random effect model was chosen after running the Hausman test for model appropriateness. All the diagnostics were conducted to ensure reliability of results.

### **3.6.3 Conceptual Model Specification**

Different techniques are being used to analyze food insecurity at either community, or household level as the case may be. Some use ordinary least squares regression on daily consumption expenditure while others (Amaza P.S and et.al 2006) use probability modeling to study it.

Therefore, an econometric model is specified below relating the response variable to its regressors. The basic structure of the model is given below:

$$Y_{ij} = \beta \cdot X_{ij} + u_j + \epsilon_{ij}$$

Where  $i$  represents the household and  $j$  represents the cluster. In this case, the heterogeneity in food insecurity that we sought to examine is at the cluster ( $j$ ) level.  $Y$  is the food security status binary variable and  $X$  represent the regressors

that are included in the model. The above model can be expanded as below to show both the regressand and all the regressors in the model.

$$\mathbf{Food\_Security}_{ij} = \beta_0 + \beta_1 \mathbf{OWN\_PRODUCE}_{ij} + \beta_2 \mathbf{AgeHH}_{ij} + \beta_3 \mathbf{Loghhincometotal}_{ij} + \beta_4 \mathbf{Educationgroupeddumy}_{ij} + \beta_5 \mathbf{Employment\_dummy}_j + \beta_6 \mathbf{Region}_{ij} + \beta_7 \mathbf{Gender}_{ij} + \beta_8 \mathbf{HHSize}_{ij} + \epsilon_{ij} + u_j$$

Where;

$\mathbf{Food\_Security}_{ij}$  = Food security status of household  $i$  living in community  $j$

$\mathbf{Own\_Produce}$  = Kilogram quantities of the total goods produced by the household

$\mathbf{AgeHH}$  = Age of head of the household

$\mathbf{Loghhincometotal}$  = This is a continuous variable for the log of total household income.

$\mathbf{Gender}$  = this is a dummy for the sex of the head of the household, where 0=male and 1=female

$\mathbf{Educationgroupeddumy}$  = is a variable describing different levels of education attainment

$\mathbf{Employment\_dummy}$  = is a categorical variable for the different kinds of employments by heads of the households in luapula

$\mathbf{Region}$  =this is a dummy describing rural and urban area of luapula Province.

$\mathbf{PSU}$  =this is the primary sampling unit.

$\epsilon_{ij}$  = error term

$u_j$  = error term at community (cluster) level

With multiple observations at the cluster level, we run a FE model to show if there are unobserved factors at the cluster level that affect household food insecurity pre-disposition. The basic intuition is that food insecurity may be affected by geographical location due to weather patterns, absence of local markets, etc., which are likely to operate at the cluster level. When tested for the

relevance of fixed vs random effects using the Hausman test, the test results showed that the FE model was appropriate.

#### **3.6.4 Logistic regression diagnostics**

Under the logistic regression procedure, it is assumed that the true conditional probabilities are a logistic function of the independent variables and that no important variables are omitted in the model. It is also assumed that all the independent variables are measured without error and are not linear combinations of each other. In order for the analysis to be valid, the study carried out key diagnostics on the empirical model to check if these assumptions of logistic regression would be met to avoid problems such as biased coefficient estimates which could have resulted into invalid statistical inferences.

The joint hypothesis testing was done using the likelihood ratio test. A p-value of 0.000 was obtained based on 62 numbers of groups. The chi square p-values show that the join hypothesis is statistically significant. Furthermore, the Durbin-Wu-Hausman test was used to test for the model appropriateness. This is often used to discriminate between the fixed and the random effects model. The chi square probability value of 0.9999 shows that we have enough evidence to fail to reject the null hypothesis which states that random effects model is appropriate (Appendix B). We therefore conclude that random effect model is appropriate for this data and should be used for the analysis.

## CHAPTER FOUR

### RESULTS AND FINDINGS

#### 4.1 Introduction

The study analyzed various factors that determine food insecurity in Luapula province. A number of potential variables are included in the model on the basis of theoretical models discussed in literature review. This section presents the results and findings of the study using the treatment variables outlined in the objectives, thus; age , Own produce, Household size, log of total income, dummy variables of gender, Region, employment status and education status . The logistic regression coefficients and odds ratios are then analyzed to test the hypothesis that the likelihood of the household being food insecure is related to the given regressors.

#### 4.2. Response Variable

Table 4.1 below show that 35.34 % of the 1,129 households in Luapula province are food secure, while 64.66% are found to be food insecure in Luapula province. Food insecurity is the base category.

**Table 4.1 Distribution of the households according to their food security status**

| Recode of Per<br>Capita<br>Expenditure | Frequency | Percent | Cum    |
|--|-----------|---------|--------|
| Food Insecure                          | 730       | 64.66   | 64.66  |
| Food Secure                            | 399       | 35.34   | 100.00 |
| Total                                  | 1129      | 100.00  |        |

### **4.3. Descriptive statistics for independent variables**

Descriptive statistics of this study are reported in Table 4.2. A total of 1129 households were included in the analysis of which (24%) were females. This is less than the national average of 51% for females in Zambia. More than half (56%) of the head of the households were from rural areas in comparison to the national average, the result is slightly less than the national average which indicate that 57% of the head of households reside in rural areas, while 43% are in urban areas. The mean age for the head of the household was 45 years, with the oldest head of the household having 90 years while the youngest only 20 years of age. The mean age for the household head was found to be lower than the national average which stood at 47% (RALS, 2015).

Out of 1129 households in luapula, only 399(35%) were found to be food secure. The average household size (5.4) for luapula province was higher than the national average of 5.1. However, the national surveys acknowledged that average household size tend to be larger in rural areas (5.2) than in urban areas (5.0) (LCMS, 2015). additionally, the national statistics also indicate that male headed households tend to have larger average household size than female headed households.

In terms of education, 40% of household heads attained primary level of education, 10% lower than the national average. For secondary education, there were more household heads that attained the secondary education (32%) relative to the national average of 24%. The statistics for the percentage of heads of the households that attained tertiary education review that luapula province is 15% higher than the national average of heads of the household that attained tertiary education. The average for luapula stood at 18% while the national average was 3%. Age, Household size (HHsize), own produce, log of total Income are measured as continuous variables, while gender, Region, education status, employment status were measured as categorical or dummy variables (see table 4.2).

**Table 4.2 shows Column labeled (1) representing the number of observation for each variable. Column (2) are means while column (3) are standard deviations.**

| <b>Variable</b>              | <b>Observation<br/>(1)</b> | <b>Mean<br/>(2)</b> | <b>Standard<br/>dev(3)</b> |
|------------------------------|----------------------------|---------------------|----------------------------|
| <b>% FOOD_SECURE</b>         | 1,129                      | .353                | .478                       |
| <b>HH_size</b>               | 1,129                      | 5.437               | 2.562                      |
| <b>Own_Produce</b>           | 1,129                      | 173.994             | 252.631                    |
| <b>Age</b>                   | 1,129                      | 43.540              | 14.043                     |
| <b>logIncomeTotal_Income</b> | 1,083                      | 6.417               | 1.735                      |
| <b>Gender</b>                |                            |                     |                            |
| <b>% Female</b>              | 1,129                      | .236                | .425                       |
| <b>Region</b>                |                            |                     |                            |
| <b>% Urban</b>               | 1,083                      | .436                | .496                       |
| <b>Education Status</b>      |                            |                     |                            |
| <b>% Primary</b>             | 1,083                      | .393                | .489                       |
| <b>% Secondary</b>           | 1,083                      | .323                | .469                       |
| <b>% Tertiary</b>            | 1,083                      | .178                | .382                       |
| <b>% Not Stated</b>          | 1,083                      | .030                | 1.172                      |
| <b>Employment Status (%)</b> |                            |                     |                            |
| <b>Government Employees</b>  | 996                        | .190                | .392                       |
| <b>Private-Sector</b>        | 996                        | .058                | .234                       |
| <b>Domestic employees</b>    | 996                        | .045                | .208                       |

The number 90 under age represents the oldest head of the household in luapula province. In the same vein, region was categorized as; Rural taking the value of 0 and urban taking on the value of 1.

Table 4.3 below shows the distribution of food security status by geographic characteristic (residence) and gender of the head of the household obtained by cross-tabulation. The results show that there are more food insecure (51%) households in the rural areas than in urban areas (14%). Out of the 56.42 % of the population of households sampled in rural luapula province, only 5.82% (representing 63 households out of a total of 611 households) of households were found to be food secure. To the contrary, slightly more than half (29.46%) of the households in urban parts of luapula were found to be food secure.

Further, the results suggest that there are more male headed households (76%) than there are female (24%) . The results in the table show that for both male and female, the percentage proportion of food insecure households is almost twice the food secure households. For the male, 50% of the households were found to be food insecure, a percentage nearly twice that of the food secure households (27%).

**Table 4.3: Food security by residence (Rural and Urban) and gender of head of the household**

| Variable |        | N   | Food insecurity (%) | Food security (%) | N   | P-values |
|----------|--------|-----|---------------------|-------------------|-----|----------|
| Region   | Rural  | 548 | 50.60               | 5.82              | 63  | 0.000    |
|          | Urban  | 153 | 14.13               | 29.46             | 319 |          |
| Gender   | Male   | 560 | 49.60               | 26.75             | 302 | 0.699    |
|          | Female | 170 | 15.06               | 8.59              | 97  |          |

The results presented in Table 4.4 below reveal that food security status changed with the level of education the head of the household attained. The results presented in the tables shows that 53.64 attained primary level of education were found to be food insecure. However, as the level of education attainment increased the percentage of households that were food secure increase. The result suggests that



households whose head is a holder of either a secondary school certificate is 26% more food secure than those that never attended any form of education. Additionally, of the 192 households that attained tertiary level of education, only 19 heads of the households were found to be food insecure in luapula province.

**Table 4.4: Food security by education level attained by the head of the household**

| Variable         | N                    | Food insecurity (%) | Food security (%) | N     | P-Value |       |
|------------------|----------------------|---------------------|-------------------|-------|---------|-------|
| Education Status | Never-attended level | 73                  | 10.41             | 1.57  | 6       | 0.000 |
|                  | Primary level        | 376                 | 53.64             | 13.35 | 51      |       |
|                  | Secondary level      | 231                 | 32.95             | 31.68 | 121     |       |
|                  | Tertiary level       | 19                  | 2.71              | 45.29 | 173     |       |
|                  | Not stated           | 2                   | 0.29              | 8.12  | 31      |       |

Results presented in Table 4.5 below suggest that the highest proportion household heads were self-employed out of which 88% of those households were found to be food insecure. Household heads that worked for government were more food secure (46.52%) than any other household heads included in this study. The results also suggest that, for all the employment categories (except for self-employed and household employee), the percentage of food secure households is more than that of the food insecure households.

**Table 4.5: Food security by employment status of the head of the household**

| Variable          | Food insecurity (%) | Food security (%) | P-value |
|-------------------|---------------------|-------------------|---------|
| Self Employed     | 88.23               | 39.55             | 0.000   |
| Govt Employee     | 3.45                | 46.52             |         |
| Private Sector    | 2.35                | 11.98             |         |
| Domestic employee | 5.77                | 1.95              |         |

**Determinants of household food security**

The results of this model estimation are presented in Table 4.6 below as odds ratios. The results suggest that having a head of the household with tertiary education is associated with increased odds of being food secure (odds Ratio 4.987). This means that tertiary education of the head of the household increases the odds of a household being food secure by 4.987 compared to households that never attended any level of schooling, controlling for other factors. The variable was significant at 5%. Therefore, we have enough evidence to reject the null hypothesis which stated that education attainment has no influence on the food status of a household.

The table also shows that the total household income influence food security. Significant at 1%, this result suggest that total income of the household was associated with increased odds of being food secure. The hypothesis that income does not contribute to the food security of a household is thus rejected. Increasing the household income by k1, increase the odds of an individual household being food secure by a factor of 1.386, controlling for other factors. A 0.621 odds coefficient on household size suggests that increasing the household size by one member is associated with a 0.621 odds decrease in food security of that household, holding other things equal. Meanwhile being a government employee and private sector employee is associated with increased odds of a household being food secure, relative to self-employment. Being a

government employee is associated with a 3.417 increased odds of a household being food secure, compared with a household whose head is self-employed. Additionally, working in private sector is associated with increased odds of a household being food secure than a self-employed household.

Conversely, having a head of the household who is a domestic employee is statistically significantly associated with reduced odds of a household being food secure by a factor 0.197, compared to a self-employed household head. The findings also show that a household that produces its own produce was associated with increased odds of being food secure (1.006). The variable is significant at 1% level of significant and can thus be interpreted as a one kilogram increase in own production was associated with a 1.006 odds increase in food security, *ceteris paribus*.

We tested the second hypothesis that food security is not affected by geographical location defined as region (rural or urban). The results in table 4.6 shows that living in urban luapula is associated with a 49.771 increased odds of being food secure, compared to living in rural areas, holding other things constant. This variable was significant at 1%, which means that at that level of significant we reject the null hypothesis that food security is not affected by geographic location and conclude that region does influence food security.

**Table 4.6 shows results of coefficients of odds ratios**

| VARIABLES                                  | ODDS RATIOS           | Standard Errors |
|--|-----------------------|-----------------|
| Food secure (Dependent)                    |                       |                 |
| HH_size                                    | 0.621 <sup>***</sup>  | (0.075)         |
| Age of HH                                  | 1.008                 | (0.009)         |
| Own_Produce                                | 1.006 <sup>***</sup>  | (0.000)         |
| Total household log per capita income      | 1.386 <sup>***</sup>  | (0.102)         |
| Gender of HH head(Male=0,female=1 )        | 1.003                 | (0.310)         |
| Region of Residence (Rural=0,Urban=1)      | 49.771 <sup>***</sup> | (27.533)        |
| Education level                            |                       |                 |
| HH Never attended school (Reference group) | -                     | -               |
| Primary                                    | 0.691                 | (0.414)         |
| Secondary                                  | 1.123                 | (0.703)         |
| Tertiary                                   | 4.897 <sup>**</sup>   | (3.839)         |
| Not_stated                                 | 14.012 <sup>**</sup>  | (18.797)        |
| Employment status                          |                       |                 |
| Self_employee(Reference Category)          | -                     | -               |
| Govt employee                              | 3.714 <sup>***</sup>  | (1.592.)        |
| Private_sector                             | 3.148 <sup>**</sup>   | (1.592)         |
| Domestic_employee                          | 0.197 <sup>**</sup>   | (0.145)         |
| Constant                                   | 0.016 <sup>***</sup>  | (0.015)         |
| Insig2u                                    |                       |                 |
| Constant                                   | 0.451                 | (0.367)         |
| Insig_u                                    | 1.253                 | (0.367)         |
| Rho  | 0.323                 | (0.080)         |

Robust Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## CHAPTER FIVE

### DISCUSSION OF FINDINGS

In this Chapter, this study provides a detailed interpretation of the key empirical findings of the random effect logistic regression models.

#### 5.1 Summary of Major findings

This study has demonstrated that food security is influenced by a number of socio-economic factors. In this present study and in relation to the main objective of the study which was to establish the relationship between food security and household food characteristics, it was found that the household size, own produce, total household income, region (rural/urban), education attainment of the head of the household (degree or better), an employment status (government, private sector and domestic employee) of the head of the household were the significant predictors of food security in luapula province. Age of the head of the household, gender of the head of the household and a household head with levels of education between primary and secondary were not significant predictors of food security. These findings have profound implications on household food security status and presents new potential areas for future research.

In addressing specific objective number one, this study set out to measure the relative importance of the factors that predict food security in luapula province. To that effect, food security of an individual head of the household is by far more likely to increase (by a factor of 49.771) with one residing in urban areas, relative to those in rural areas. The second most important predictor of food security in luapula is education level of the head of the household. The food security of a household whose head has a college degree was associated with a 4.987 increased odds compared to a household whose head never attended school. Working for government by a head of the household was associated with increased odds of being food secure (3.417), compared to a household head

whose was self-employed. Private sector employment was also associated with increased odds of a household being food secure (3.148). Other factors that were significantly associated with increased odds of households being food secure in luapula are total income of the household (with the odds of 0.142) and how much (in kilograms) output a household produces (by a factor of 1.006).

To the contrary, adding one more person to the household is associated with the likelihood of that household being food secure by a factor of 0.621 and engaging in domestic works by the head of the household was associated with reduced odds of a household being food secure(0.197).

Own produce is a very important factor in determining the likelihood that a household would be food secure or not. The findings of this study showed that a household that produces its own produce is less likely to be food insecure in relation to one that does not produce its own produce. The odds ratio 1.006 on own produce can be interpreted as a one kilogram increase in the household own produce increases the odds of the household being food secure by 1.006. The variable is statistically significant at 1% level of significant, meaning that own produce is an important factor in determining food security in Luapula province. The results are also related to the findings of Sofa Team and Cheryl (2011) where owning land by women influenced them to be economically active. This is because the ownership of agricultural land enabled women to produce cash crops, hence, having a source of income. It can thus be inferred that having own produce translates to cash crops that increase the incomes of households and consequently lead to increased purchasing power.

Income is one of the major determinants of food security. From the findings of this study, a k1 increase in an individual household income per capita is associated with the odds of the household being food secure by a factor of 1.386. The findings of this study agrees with other researchers such as Jensen and Miller, (2011) who postulated that, as people become richer and their daily

calorie demand is fulfilled, they start spending more on the taste, quality and diversity of their food instead of the amount of food.

The results are also in line with what Barret (2002) found. Higher household incomes lead to improved health, nutrition, and general well-being, resulting in a virtuous cycle that can eliminate food insecurity. Similarly, low household incomes can create a vicious cycle that can make it difficult for households to escape food insecurity. Therefore, as more households have more incomes in luapula, they get to have a stronger command on goods and services which make the food secure.

Region is another key factor that was used in the model. The results show that there were varying levels of food insecurity within Luapula province. For example, households in urban areas of luapula have 49.771 increased odds of being food secure compared to households that are in rural areas. This can be attributed to the fact that there is not only greater availability, but also variety of foods in urban in comparison to rural areas. A food access disparity study by Wang and Dai (2011) also revealed that urban areas have more advantage in spatial access to food including neighborhoods with more socioeconomic disadvantages.

The results show that having access to education and obtaining an education beyond secondary school improves household food security. Having a college education increases the odds of the household being food secure by a factor of 4.987 compared to a household whose head has never attended any level of education. Human capital is essential to achieving and maintaining high labor productivity (Barrett, 2002). Better Educated individuals often possess more assets and have access to better infrastructure, providing opportunities for nonagricultural employment and reducing dependence on agricultural sources of income. Education could also improve individual' ability to use information about food choices and manage their resources better. Chapoto (2011) also observed that education is one of the pathways out of poverty for the rural

Zambians. He concluded that investment be made in secondary and post-secondary education of children which translates, in the next generation, into high-paying nonfarm employment which increase the incomes of households.

The variable household size is significantly associated with reduced odds of a household being food secure. The results show that an additional member to a household reduces the odds of that household being food secure by a factor of .621. The bigger the size of the household the more income needed to sustain it. Luapula province data showed that most households have bigger families with the maximum being a 18 member household and the average being a 5.4 member household.

This average number of members of the household is higher than the national average (5.1) and puts luapula households at a risk of being food insecure. The findings conquer with Mustapha (2015) who found that Household size has a positive relationship with food insecurity status, which means that the larger the size of households in terms of number of dependents, the more the likelihood of the households being food insecure.

Barret (2002) categorized household size into two and found that generally, having a large number of children increases the likelihood of food insecurity, while a large number of adults have little effect on food insecurity since children depend fully on others for their food access, lead to lower labor market participation for their parents, and are highly susceptible to illness and injury. Larger household sizes require increased food expenditure and competition for limited resources. Similarly, for this present study it was expected that household size would significantly impact household food security. The negative parameter could be a result of an increase in the dependency ratio in larger households (Sekhampu, 2013).

The random effect model shows that employment status of the head of the household influences postively the food security situation of a household. For



example, working for government and the private sectors rather than being self employed increase the odds of the household being food secure by factors 4.417 and 3.148 at 1% and 5% levels of significant respectively.

Unemployment can also negatively affect a household's food security status. High unemployment rates among low-income populations make it more difficult to meet basic household food needs because household would not have enough money to purchase food items.

## **5.2 Limitations**

The 2015 LCMS dataset is from a cross sectional survey. Therefore, the study could only examine the association between explanatory variables and the outcome variable. This study could not draw any conclusions about causality. Additionally, the definition of food security is too broad as the phenomenon is multi-dimensional in nature. It was therefore, very challenging for the present study to pick a single definition of food security to operationalize. Lastly, it could have benefited the research more if two measures of food security (Dietary diversity Score and the per capita consumption expenditure) were used and compared the results. Unfortunately the researcher was unable to access data from Indaba Center for Policy Research (IAPRI) and could only rely on the data obtained from CSO which did not contain dietary diversity scores.

## CHAPTER SIX

### CONCLUSION AND RECOMMENDATIONS

#### 6.1 Summary

The study aimed to investigate the determinants of food security in Luapula province. The province was chosen as it was one of the Provinces with the highest malnutrition level in Zambia. Food security was measured using the household income approach (household per capita expenditure). The findings show that 64.66% of the households are classified as food insecure, while only 35.34% were found to be food secure. Cross-sectional data from the Central Statistics office was used (precisely LCMS 2015) for this study. The study was aimed at investigating the household characteristics that affect food security in Luapula province. Mixed effect logistic models were used with random effect being chosen as the appropriate model.

There have been attempts at combating food poverty, malnutrition and household food insecurity. However, the problem of food security remains an issue for concern and for possible policy response as it points to nutritional deficiencies and increased hunger and poverty, especially for people living in rural areas. This study has identified the determinants of households' food security in Luapula province.

The results of this study indicate that household size, own produce, region, education and employment are significant predictors of food security in Luapula province. Having a college education is associated with increased odds of being food secure compared with households headed by individuals that never attended any level of education. Being a government employee was also associated with increased odds of being food secure, compared to a household whose head is in private employment. Furthermore, the amount of income due to a household is associated with increased odds of that household being food secure. Meanwhile household size is associated with reduced odds of being food secure or increases the odds of a household being food insecure. The other

variable that was associated with increased odds of a household being food insecure was a household head being a domestic employee.

In terms of relative importance, the study shows that region is the variable associated with the most increased odds of a household being food secure. This is to say that belonging to an urban area in Luapula province increases the odds of the household being food secure by 49.771 compared to the households in rural areas in Luapula. Education is the second most predictor of food security in Luapula province. Having a college degree is associated with a 4.987 odds of being food secure compared to those households whose head has no schooling. Employment that is both government and private is the third and fourth most important predictor of food security in Luapula province. From the results in the previous chapter, being a government or private sector employee increased the odds of being food secure by factors 3.417 and 3.148 respectively. Finally, own production and total income of the household are the fourth and fifth predictors of food security in Luapula province.

To the contrary, two variables namely household size and domestic employment are associated with increase odds of food insecurity. Household size is more associated (0.621) with the increased odds of a household being food insecure than being a domestic employee (0.197)

The variable called PSU was used to control for the cluster level effects in the model. The results showed that rho was statistically significant from the model, which means that 32.3% of the effect on food security is due to cluster effects rather than individual effects.

## **6.2 Policy Recommendations**

- i. Based on the findings, the dissertation wishes to recommend the following: There is need for targeted, social protection approach given that the marginalized are more at risk of food insecurity. Policies that do not target the marginalized and only administered at national level might not reach the households that need them the most.

- ii. The study found that a household is more likely to be food secure by producing an extra unit of output. Therefore, there is need for consistency in agricultural policies that encourage households to produce their own produce as this contributes immensely to the food security of a household in luapula.
- iii. Family planning education awareness campaigns should be undertaken to mitigate the negative effect that household size exert on the food security status of a household.

### **6.3 Areas for future research**

- i. A study can be done to investigate factors that influence food insecurity in different provinces of Zambia so as to establish national and province specific drivers of food insecurity in Zambia.
- ii. Other studies can also be done to establish the impact of various food programs in Zambia and answer the question why food insecurity has remained high despite the interventions.

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## APPENDICES

### Appendix A: Estimation of Fixed and random effect

The Fixed effect and random effect parameters were estimated using the logit coefficients (log odds) and the results are presented in table 4.3 below:

|                  |                | (1)           | (2)           |
|------------------|----------------|---------------|---------------|
| Variables        | Categories     | Fixed effects | Random effect |
| HH_Size          | Household size | -.4781613*    | -.5043166*    |
|                  |                | (0.0636249)   | (.0059275)    |
| Own_produce      | Own produce    | 0.0064381*    | .0059275*     |
|                  |                | (0.0009996)   | (.0007835)    |
| Age              | Age of HH      | 0.0028981     | .0068414      |
|                  |                | (0.0098502)   | (.0090097)    |
| Logoftotalincome | Log of Income  | 0.2491093**   | .354332*      |
|                  |                | (0.1143008)   | (.1447148)    |
| Gender           | Male (Base)    |               |               |
|                  | Female         | -0.0590592    | -.0082185     |
|                  |                | (0.334797)    | (.2732779)    |
| Region           | Rural (Base)   |               |               |
|                  | Urban          | Omitted       | 3.852856*     |
|                  |                |               | (0.560812)    |
| Education level  | Grade 1-7      | -0.5780925    | -.3756959     |
|                  |                | (0.6221103)   | (.5013121)    |
|                  | Grades 8-9     | -0.3001478    | -.1003235     |
|                  |                | (0.6801707)   | (.5452286 )   |
|                  | Grades 10-12   | 0.1856628     | .4453836      |
|                  |                | (0.6858676)   | (.5370797)    |
|                  | A-level        | 17.02357      | 2.219489      |

|                   |                             |              |              |
|-------------------|-----------------------------|--------------|--------------|
|                   |                             | (1394.078)   | (.6322107)   |
|                   | Certificate/Diploma         | 0.4202131    | 1.24351      |
|                   |                             | (0.8439557)  | (.9097847)   |
|                   | Degree or higher            | 1.152575     | 2.31225*     |
|                   |                             | (1.374013)   | (1.230042)   |
|                   | Not stated                  | 0.7116644    | 2.244914     |
|                   |                             | (1.368341)   | (1.332447)   |
| Employment status | Central government employee | 1.610013*    | 1.800029*    |
|                   |                             | (0.6174437)  | (.6026194)   |
|                   | Local government employee   | 0.6997226    | .5612708     |
|                   |                             | (0.8368242)  | (.691471)    |
|                   | Parastatal employee         | -2.076996*** | -2.12212***  |
|                   |                             | (1.191008)   | (.8614627)   |
|                   | Private sector employee     | 0.836085     | 1.029301***  |
|                   |                             | (0.5060252)  | (.5282851)   |
|                   | NGO employee                | 15.26005     | 0(empty)     |
|                   |                             | (4032.937)   |              |
|                   | Partner                     | 15.65055     | 0(empty)     |
|                   |                             | (13149.49)   |              |
|                   | Household employee          | -15.89601    | 0(empty)     |
|                   |                             | (1765.603)   |              |
|                   | Unpaid family worker        | -14.37932    | 0 (empty)    |
|                   |                             | (1738.031)   |              |
|                   | Piece worker                | -2.076996    | -1.761124*** |
|                   |                             | (1.179326)   | (.7597915)   |
|                   | Others                      | 15.5375      | 1.41887      |
|                   |                             | (6509.699)   | (.8297553)   |

|          |          |  |               |
|----------|----------|--|---------------|
| Cons     | Constant |  | -4.099502 *** |
|          |          |  | (1.049164)    |
| /insig2u |          |  | .3846884      |
|          |          |  | (.4360026)    |
| Sigma_u  |          |  | 1.212088      |
|          |          |  | (.2642367)    |
| Rho      |          |  | .3087096      |
|          |          |  | (.0930464)    |

Robust Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table above estimates the log odds that show the direction of influence, thus, either a positive or negative way. As shown in the table above, variables such as, own produce, log of income, region and some categorical variables such education level and employment status are positively related food security in both models. On the contrary, variables such as household size, gender and education level land employment level are negatively related to household food security in both models.

### **Appendix B Test for suitability of Fixed or Random effect models**

The Durbin–Wu–Hausman test is often used to discriminate between the fixed and the random effects model. Table 4.4 shows the Hausman test to choose which model is appropriate between the random and fixed effects.

|              | Coefficients |           |                     |                             |
|--------------|--------------|-----------|---------------------|-----------------------------|
|              | (b)<br>FE    | (B)<br>RE | (b-B)<br>Difference | sqrt(diag(V_b-V_B))<br>S.E. |
| HH_size      | -.4781613    | -.5043166 | .0261553            | .0102868                    |
| Own_Produce  | .0064381     | .0059275  | .0005106            | .0004394                    |
| Age          | .0028981     | .0068414  | -.0039433           | .0027032                    |
| logIncomeT~1 | .2491093     | .354332   | -.1052226           | .0395741                    |
| 2.Gender     | -.0590592    | -.0082185 | -.0508407           | .1115664                    |
| Education_~1 |              |           |                     |                             |
| 1            | -.5780925    | -.3756959 | -.2023966           | .1570262                    |
| 2            | -.3001478    | -.1003235 | -.1998243           | .183583                     |
| 3            | -.1856628    | .4453836  | -.6310464           | .1777815                    |
| 4            | 17.02357     | 2.219489  | 14.80409            | 1394.077                    |
| 5            | .4202131     | 1.24351   | -.823297            | .2627999                    |
| 6            | 1.152575     | 2.31225   | -1.159675           | .2604001                    |
| 9            | .7116644     | 2.244914  | -1.533249           | .0889013                    |
| Employment~s |              |           |                     |                             |
| 2            | 1.610013     | 1.800029  | -.190017            | .2667416                    |
| 3            | .6997226     | .5612708  | .1384518            | .                           |
| 4            | -2.313985    | -2.12212  | -.1918649           | .4514759                    |
| 5            | .8306085     | 1.029301  | -.198693            | .1226957                    |
| 11           | -2.076996    | -1.761124 | -.3158726           | .593036                     |
| 12           | 15.5375      | 1.41887   | 14.11863            | 6509.699                    |

b = consistent under Ho and Ha; obtained from xtlogit  
B = inconsistent under Ha, efficient under Ho; obtained from xtlogit

Test: Ho: difference in coefficients not systematic

chi2(2) = (b-B)'[(V\_b-V\_B)^(-1)](b-B)  
= 0.00  
Prob>chi2 = 0.9999

From the table above, the chi square probability value of 0.9999 shows that we have enough evidence to fail to reject the null hypothesis which states that random effect is appropriate. We therefore conclude that random effect model is appropriate for this data and should be used for the analysis.

### Appendix C. Joint Hypothesis testing; Likelihood Ratio test

|                        |        |
|------------------------|--------|
| Number of observations | 970    |
| Number of groups       | 62     |
| Likelihood Ratio Chi2  | 297.52 |
| Probability>chi2       | 0.000  |
| LR test of Rho=0 chi2  | 34.62  |
| Probability>chi2       | 0.000  |

## Appendix D Logistic regression output from Stata

```

Random-effects logistic regression      Number of obs   =      970
Group variable: PSVL                  Number of groups =      62

Random effects u_i ~ Gaussian          Obs per group:
                                        min =          10
                                        avg =         15.6
                                        max =          25

Integration method: mvaghermite        Integration pts. =      12

Wald chi2(19) =      159.05
Prob > chi2   =      0.0000

Log likelihood = -254.42636

```

| FOOD_SECURITY                    | Coef.     | Std. Err. | z     | P> z  | [95% Conf. Interval] |           |
|----------------------------------|-----------|-----------|-------|-------|----------------------|-----------|
| HH_size                          | -.5043166 | .0627878  | -8.03 | 0.000 | -.6273784            | -.3812548 |
| Own_Produce                      | .0059275  | .0008979  | 6.60  | 0.000 | .0041676             | .0076873  |
| Age                              | .0068414  | .009472   | 0.72  | 0.470 | -.0117234            | .0254062  |
| logIncomeTotal                   | .354332   | .1072314  | 3.30  | 0.001 | .1441624             | .5645016  |
| Gender                           |           |           |       |       |                      |           |
| Female                           | -.0082185 | .3156611  | -0.03 | 0.979 | -.626903             | .6104659  |
| Region                           |           |           |       |       |                      |           |
| Urban                            | 3.852856  | .560812   | 6.87  | 0.000 | 2.753685             | 4.952027  |
| Education_Level                  |           |           |       |       |                      |           |
| Grades 1-7                       | -.3756959 | .6019668  | -0.62 | 0.533 | -1.555529            | .8041373  |
| Grades 8-9                       | -.1003235 | .654927   | -0.15 | 0.878 | -1.383957            | 1.18331   |
| Grades 10-12                     | .4453836  | .6624259  | 0.67  | 0.501 | -.8529474            | 1.743715  |
| A-Level                          | 2.219489  | 1.687608  | 1.32  | 0.188 | -1.088162            | 5.52714   |
| Certificate/diploma              | 1.24351   | .8019959  | 1.55  | 0.121 | -.328373             | 2.815393  |
| Degree or higher                 | 2.31225   | 1.349112  | 1.71  | 0.087 | -.3319612            | 4.956461  |
| Not stated                       | 2.244914  | 1.36545   | 1.64  | 0.100 | -.4313187            | 4.921146  |
| Employment_Status                |           |           |       |       |                      |           |
| CENTRAL GOVT EMPLOYEE            | 1.800029  | .5568533  | 3.23  | 0.001 | .708617              | 2.891442  |
| LOCAL GOVT/COUNCIL EMPLOYEE      | .5612708  | .8556248  | 0.66  | 0.512 | -1.115723            | 2.238265  |
| PARASTATAL/ QUASI- GOVT EMPLOYEE | -2.12212  | 1.10212   | -1.93 | 0.054 | -4.282236            | .037996   |
| PRIVATE SECTOR EMPLOYEE          | 1.029301  | .4909249  | 2.10  | 0.036 | .0671064             | 1.991497  |
| NGO EMPLOYEE                     | 0 (empty) |           |       |       |                      |           |
| EMPLOYER/PARTNER                 | 0 (empty) |           |       |       |                      |           |
| HOUSEHOLD EMPLOYEE               | 0 (empty) |           |       |       |                      |           |
| UNPAID FAMILY WORKER             | 0 (empty) |           |       |       |                      |           |
| PIECE WORKER                     | -1.761124 | 1.019371  | -1.73 | 0.084 | -3.759054            | .2368072  |
| OTHER SPECIFY)                   | 1.41887   | 2.817152  | 0.50  | 0.615 | -4.102646            | 6.940386  |
| _cons                            | -4.099502 | .9534534  | -4.30 | 0.000 | -5.968236            | -2.230768 |
| /lnsig2u                         | .3846884  | .3916216  |       |       | -.3828759            | 1.152253  |
| sigma_u                          | 1.212088  | .2373399  |       |       | .8257709             | 1.779133  |
| rho                              | .3087096  | .0835752  |       |       | .1716862             | .4903525  |

LR test of rho=0: chibar2(01) = 34.62

Prob >= chibar2 = 0.000