THE EFFECTS OF FARMER ACCESS TO CREDIT ON DIETARY DIVERSITY IN ZAMBIA

By

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DECLARATION

I Mambwe Shiyenge, declare that this research project is my own work. The research is submitted in partial fulfilment of the requirements for obtaining a Master of Arts degree in Economics of the University of Zambia.

I further declare that:

1. This dissertation is my original work and has not been presented for a degree in any other University or any other award.
2. I had obtained the necessary authorization and consent to carry out this research.

Signed……

Date……...

APPROVAL

This dissertation of **Mambwe Shiyenge** has been approved as a partial fulfilment of the requirements for the award of the degree of Master of Arts in Economics by the University of Zambia.

Examiner 1 ……

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Examiner 3 ……

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ABSTRACT

Farmer access to credit is one of the financial solutions for addressing malnutrition, having been extensively researched in several countries with multiple studies concluding that access to credit has the potential to improve a smallholder household's dietary diversity and ultimately reduce malnutrition. However, limited literature exists to clarify this association in Zambia. To address the knowledge gap and understand this association. The study examined how farmer access to credit affects Zambia's dietary diversity. The study used an instrumental variable approach where Loan society membership and the Headman/Headwoman's relation to the household head are instrumental variables on data collected from the Rural Agricultural Livelihood Survey (RALS) of 2015, which covered 7934 agricultural households from 10 provinces. The results indicate that smallholder household's that accessed credit consumed at a significantly higher dietary diversity compared to otherwise, with a difference of 0.352units at a p-value=0.040. However, these results are limited to smallholder households that are also likely to receive FISP. At the same time, education attainment to secondary and tertiary levels lowered a household's dietary diversity than no years spent in formal education with a significant difference of 0.119 and 0.221units, respectively. At a p-value=0.013 for secondary education and p-value=0.004 for tertiary education attainment. The study suggests that access to agricultural credit can improve a household's dietary diversity. Whereas increasing the number of families pursuing higher education attainment enhances the household's nutritional awareness and preference to consume various food groups. The study further suggests that measures to promote the financial inclusion of smallholder farmers in agricultural credit are crucial. Though further research is needed to identify the long term effect of credit access on household dietary diversity.

Keywords: *farmer access to credit, Dietary diversity, Malnutrition, Instrumental variable.*

DEDICATION

I dedicate this work to my Lord Jesus Christ, for seeing me through my studies.

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ABBREVIATIONS	DESCRIPTION
IAPRI	Indaba Agricultural Policy Research Institute
FISP	Farmer Input support Programme
HDDS	Household dietary diversity score
AHM	Agricultural Household Model
RALS	Rural agricultural livelihood survey
WHO	World Health Organization
WFP	World Food Programme
FAO	Food Agricultural Organization
FCS	Food Consumption Score
IV	Instrumental Variable

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Globally nearly half of all infant mortalities result from malnutrition (Justus et al., 2017), which is most persistent in sub-Saharan Africa and South Asia (WHO, 2018). As a result, the United Nations through the agenda in the Decade of Action on Nutrition for 2016 to 2025 has put in measures to eradicate all forms of malnutrition like undernutrition, micronutrient deficiencies, obesity and over-weight by providing all people with access to better and more sustainable diets to prop up their nutrition (UNSCN, 2019). However, despite the significant effort to reduce under-nutrition worldwide through the implementation of the United Nations Decade of Action on Nutrition agenda (UNSCN, 2019). South Asia and sub-Saharan Africa remain home to 40% of the malnourished children, with approximately more than 2 billion people suffering from micronutrient malnutrition (IFAD, 2014), mainly due to insufficient intake of vitamins and minerals to support a healthy life (Kilbrom & Matin, 2017).

Ironically, most of the malnourished people come from smallholder households even though most of the food in South Asia and sub-Saharan Africa originates from smallholder farming households (IFAD, 2014). Making the smallholder sector a crucial entry point for policy intervention to improve household nutrition. Moreover, high malnutrition levels in sub-Saharan Africa have been prominent in Zambia as the global hunger index report (GHI) ranks Zambia as one of the highly malnourished countries in sub-Saharan Africa and the fifth most malnourished country worldwide after; Central African Republic, Chad, Yemen, and Madagascar (Grebmer et al., 2018).

In Zambia, smallholder farmers make up 75% of the farming population (Marjolein & Jody, 2017). Furthermore, it is the vulnerable smallholder farmers who depend heavily on rain-fed seasonal agricultural production that suffers a heavy nutritional burden. Due to persistent water challenges, which make it difficult for smallholder farmers to maintain nutritious foods and

because most of the households are poor without sufficient buying power, they fail to cover for the household members (SPRING, 2017). Leading to dietary diversity challenges where the family is unable to provide its members with enough nutritious foods like; fresh fruit and vegetables, legumes, meat, and milk (WHO, 2016; Justus et al., 2017) to improve their nutrition.

According to Kennedy et al. (2013), FAO defines dietary diversity as the number of food groups an individual can consume in a given recall period and uses it as a measure to describe the nutrition adequacy of a population-based on the quality of the diversified diets they are consuming (Kennedy et al., 2013). FAO identifies two measures of dietary diversity the; Food Consumption Score (FCS) and Household Dietary Diversity Score (HDDS). The significant difference between the FCS and the HDDS is that the FCS aggregates household information on dietary diversity based on the frequency of food groups consumed over the previous week (7days) (WFP, 2015; Project, 2018). At the same time, HDDS measures dietary diversity scores from the household's food consumption in a day (WFP, 2015; Project, 2018). In Zambia, the RALS report of 2015 showed a high percentage of households not consuming well-diversified diets. Mainly, figure 1 below indicates that 32.5% of smallholder households consumed at a lower level of HDDS. These households consumed four or fewer food groups. Most families fall under the medium level of HDDS at 58.1%. These households consumed 5 to 8 food groups, showing slightly more dietary diversity. Only 9.4% of smallholder households consumed more than nine food groups at a high level of HDDS, indicating a high percentage of households not consuming well-diversified diets.

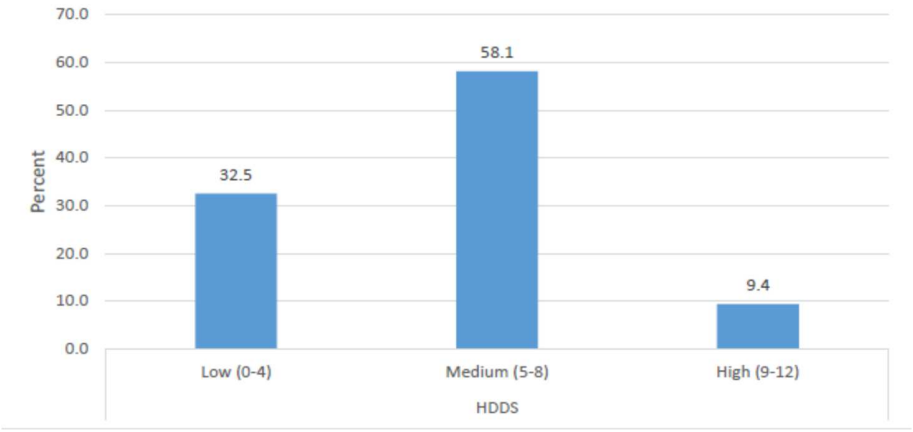

figure 1 household Dietary Diversity

Source: RALS 2015 report

However, studies have shown that there are several channels in which dietary diversity can be affected, for example, smallholder farmers can diversify their produce into pastoral and crop farming to be able to consume a more diversified diet (Demeke et al., 2017). Also, by selling some of these products, a household earns an income to buy a variety of food that the family isn't able to produce (Schaetzel et al., 2014).

On the other hand, households can improve dietary diversity by producing in bulk, not for consumption but for sale where the smallholder farmer chooses to either grow a single crop or a variety of plants. To generate enough income to purchase a variety of food for consumption (Tadesse et al., 2016).

In this regard, access to credit can provide this income to improve the smallholder household's liquidity and help ease temporal consumption shocks (Annim and Frempong, 2018; Jalil, 2015). In Zambia, Silumbu (2012) indicates that some households use credit to ease their liquidity limitations. Still, it is unclear whether their nutrition can improve if families applied some of that credit to consumption.

Moreover, through the farmer input support programme (FISP), the government has been providing smallholder farmers with input support. Such as fertiliser and seeds in a strategy to enhance food consumption and income generation (Magasu, 2016; William, Jayne, and Nicholas, 2012). Although FISP is restrictive, it makes farmers dependent on the inputs supplied by the government with limited autonomy to produce other varieties of food. Which might be more profitable and nutritious than the crops received as inputs (Lukwesa, 2014). Compared with credit access, which gives smallholder farmers more autonomy to produce and consume a variety of food groups (Lukwesa, 2014).

Furthermore, credit access is in two parts. The first is the credit via inputs received by smallholder farmers, unlike FISP, a Government subsidy meant to improve smallholder access to farming-inputs. Institutions like out-grower schemes offer credit access via farming-inputs. These are private commercial firms that ensure a constant supply of agricultural products by giving input credit to an individual or a group of smallholder farmers (Katharina & Denise, 2008). The out-grower schemes allow smallholder farmers to generate liquidity to drive up the household's food group consumption diversity.

In contrast, the second type of credit is cash credit via commercial banks and micro-financial institutions. However, it is also possible that access to credit can complement the efforts of FISP if households applied some of the fertilizer received from FISP to input credit. In turn, this can drive-up the smallholder farmers' production of food groups, and liquidity enhancing the household's dietary diversity.

Therefore, the study examines the effect of farmer access to credit on dietary diversity in Zambia. The study hypothesis is that smallholder farming households that access credit are more likely to consume a diverse range of food-groups daily. The study used data from the Rural Agricultural Livelihood Survey (RALS) of 2015 and discussed the following: section (1.2) statement of the problem. Section (1.3) objectives that are guiding this study. Section (1.4) research questions. Section (1.5) research hypothesis. Section (1.6) provides the study rationale in the Introduction section. The second section (2.0) discusses the literature review starting with the conceptual framework (2.1). Then the theories related to access to credit and dietary diversity in (2.2) narrowing down to the empirical literature on access to credit and dietary diversity. Including the determinants of dietary diversity in (2.3). The third section of the study (3.0) describes the methodology employed in the study. The fourth section (4.0) covers the results and the discussion of results. Finally, the last chapter (5.0) highlights the summary of the key findings, policy implications, and the areas of further research.

1.2 Statement of the problem

Reduced dietary diversity is prominent in Zambia (Chapoto and Zulu, 2015). For example, in 2015, nearly half of smallholder households consumed at a low nutritional level. Only 9.4% of the households consumed at a high dietary diversity (Chapoto and Zulu, 2015), indicating poor nutritional habits among families. Incidentally, this is a catalyst for increased child malnutrition, seeing that the household acts as a caregiver and determiner of the overall member's nutrition status, especially children (WHO, 2018). Notably, the burden posed by malnutrition is prominent among children in poor households. Where approximately:

- 61% of children die before the age of 5 per 1000 live births (CSO, 2018; UNICEF, 2019),
- 35% of the children under-5 years of age are stunted (smaller than their age),

- 12% of the children are underweight (low weight for age),
- 5% of the children are estimated overweight (obese),
- And 53% of adolescents who begin childbearing at 19 years of age are malnourished and mostly have underweight babies (CSO, 2018).

However, studies have shown that access to credit can be a solution for dietary diversity (Jalil, 2015; Annim and Frempong, 2018); it is not clear if this relationship holds for Zambia. Although the literature has established this relationship in other countries, no study has examined this association in Zambia. Moreover, in Zambia, access to credit is low, with only 15% of smallholder farming households' country-wide have access to agricultural credit (Chapoto and Zulu, 2015). Suppose this study can establish that access to credit improves dietary diversity in Zambia. There could be value in enhancing financial inclusion in agricultural credit as a way to prop up nutrition in Zambia.

1.3 Objectives of the study

1.3.1 General objective

To empirically investigate the effects of farmer access to credit on dietary diversity in Zambia.

1.3.2 Specific objectives

i. To examine the effects of smallholder farmer credit access on dietary diversity.

ii. To assess the effect of social demographic and economic factors like age, sex, marital status, farm size, education, household size, FISP, and residence on dietary diversity.

1.4 Research questions

1.4.1 General research question

What are the effects of farmer access to credit on dietary diversity in Zambia?

1.4.2 Specific questions

i. What are the effects of smallholder farmer credit access on dietary diversity?

ii. What are the effects of social demographic and economic factors like age, sex, marital status, farm size, education, household size, FISP, and residence on dietary diversity?

1.5 Research hypothesis

i. Smallholder farming households that access credit are more likely to consume a diverse range of food groups daily.

ii. Social demographic and economic factors like age, sex, marital status, farm size, education, household size, FISP, and residence have a significant influence on the range of food groups that smallholder households consume daily.

1.6 Study rationale

The relevance of this study is that it will give insight into the effects of farmers accessing credit on dietary diversity in Zambia. Several studies have established this relationship in other countries, though it remains unclear in the Zambian context. And filling this knowledge gap will help; concerned stakeholders, policymakers, and program planners working on livelihood, financial inclusion, agriculture, health, and nutrition to structure better policies on; financial inclusion of smallholder farmers in the credit market, dietary diversity, food, and malnutrition, besides helping the concerned stakeholders to structure better policies. This study will also contribute to the existing body of literature on access to credit and dietary diversity.

1.7 Summary

This chapter explained the background to the study of Household dietary diversity in Zambia, further presenting the statement to the problem together with the research objectives, questions and hypothesis, and the study rationale. The next chapter will discuss the literature review.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter explores three parts of the literature review; the first part reviews the conceptual framework relating to the study. The second part discusses the various theories related to the research in the theoretical literature. And finally, the last section presents the empirical studies conducted by several scholars regarding the study.

2.1 Conceptual framework

Access to credit is one of the significant determinants for household consumption and dietary diversity. It enhances the household's income allowing the family to buy farm inputs and consume varieties of food that they aren't able to produce (Jalil, 2015). The household's income increases the households' demand for food groups to maximize their dietary diversity (Levin and Milgrom, 2004; Singh et al., 1986). However, (Mette and Havard, 2014) established that several factors other than an intuitive preference for certain foods plays a role in the consumption decisions of a household and that there are different ways to categorize these factors regarding smallholder consumption choices. Literature has shown that the following variables can affect the smallholder household's consumption choices. Including; age, sex, education level, marital status, household size, and residence, including social-economic factors, such as; FISP, farm size, agricultural advice, and the distance to an agricultural market. The smallholder household's choice of food inputs for consumption is similar to the variables included in the study of (Jalil, 2015) and the reduced neoclassical investment theory suggested by (Ghorbani and Mansoori, 2008). The conceptual framework below illustrates the highlighted narrative.

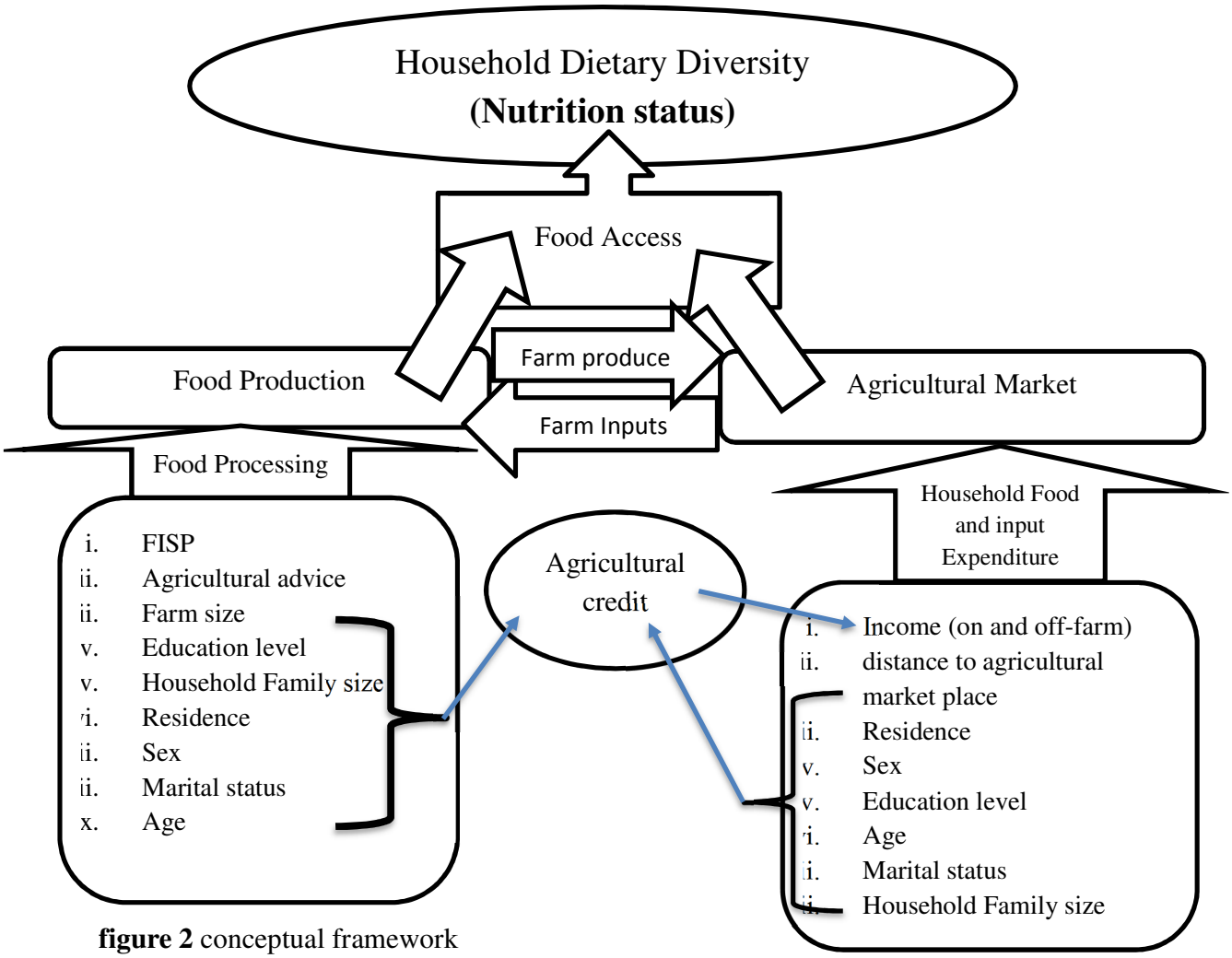

figure 2 conceptual framework
Source: Author

2.2 Theoretical literature

Several theories can be associated with the link between access to credit and dietary diversity, such as; the theory of a consumer, the Agricultural Household Models (AHM), and the neoclassical investment theory. According to Levin and Milgrom (2004), the theory of a consumer is concerned with how rational consumers make consumption decisions focusing mostly on the demand side. Where consumer consumption choices derive from dietary diversity, they can gain from consuming various food groups. Subject to a budget constraint where consumers cannot consume more food than they can buy. The level of dietary diversity is dependent on the consumer's income.

The theory clarifies that a consumer makes rational decisions to maximize dietary diversity depending on the income available to buy the food. However, smallholder farmers act as producers and consumers of food such that an increase in revenue is not restricted to purchase ready food only, but also implies spending on farm inputs to produce food for income generation and home consumption. The Agricultural Household Models (AMH) complements the consumer theory by expressing the ensued benefits of income on dietary diversity through consumption and production expenditures (Singh et al., 1986).

Mainly, the Agricultural Household Models established by (Singh et al. (1986) argue that consumption alone cannot fully explain dietary diversity. The theory further insists on discussing both production and consumption theories (Singh et al., 1986), establishing that smallholder decision making on dietary diversity consists of both production and consumption. Because smallholder households act as both producers and consumers of the food they produce, also, a smallholder household acting as a consumer will make consumption decisions to maximize the satisfaction they get from dietary diversity. Furthermore, during the production of food groups, smallholder household production decisions are influenced by their need to generate income and maximise profits (Singh et al., 1986). Still, Mette and Havard (2014) argued that the consumer's choice to consume at a higher dietary diversity might depend on several factors other than the consumer's intuition, as highlighted in the reduced neoclassical investment models explained by Ghorbani and Mansoori (2008). The models incorporate social demographic and economic factors as the determinants of household investment in dietary diversity. The theory states that the size of credit required on an agricultural investment depends on the desired level of dietary diversity the farmer wants to achieve, which is also dependent on the farm size reserved to produce enough food for consumption to enhance investment in dietary diversity. The reduced neoclassical investment model emphasizes household characteristics such as the age of the household head, education level of the household head, sex of household head, residence, the distance to an agricultural market, the household size, and the household head's marital status in influencing household's investment in dietary diversity. The model emphasizes the role of these variables in shaping household preferences. Ghorbani and Mansoori (2008) stresses the significance of the reduced neoclassical theory in determining household investment in dietary diversity. Because the approach incorporates the role that credit plays in the long-term to enhance dietary diversity

compared to the original neoclassical investment theory that ignored the part of credit access and considered the user costs or prices on farms. However, the reduced neoclassical model used a cross-sectional dataset that assumes that user costs or expenses in all farms are equal and exclude the pricing variable (Gershon et al., 1990). In conclusion, the theories reviewed in the empirical literature can trickle down to a practical model that outlines how these theories have characterized the guiding principles of this study.

2.2.1 Theoretical model

Smallholder household consumption behaviour can best be understood using the theory of a consumer explained by (Levin and Milgrom, 2004), the Agricultural Household Models (AHM) as established by (Singh et al., 1986), and the reduced Neoclassical investment theory explained by (Ghorbani and Mansoori, 2008). These theoretical models highlighted have analysed the role that credit plays in enhancing the household dietary diversity, and none of the theories so far has decisively proved to be better than the others. Because they all explain this association and a direct practical application of the arguments is that, credit access improves a smallholder household's income and dietary diversity. However, food choice for consumption depends on social demographic and economic factors (Mette and Havard, 2014). Furthermore, the next section of the literature review is the empirical literature. Which explains the factors that affect dietary diversity starting with smallholder access to credit.

2.3 Empirical literature

2.3.1 The link between smallholder farmer access to credit and dietary diversity.

In Zambia, several studies have associated dietary diversity with other variables. However, the studies do not explain how the role of credit is impacting dietary diversity. In particular, Lukwesa (2014) utilized; simple random, multi-stage, and stratified purposive sampling frames to collect data from 140 small-scale farmers in the Chongwe District of Lusaka province. The study used Ordinary Least Squares (OLS) to conduct a comparative analysis of FISP and the private sector credit programmes in promoting agricultural growth in Zambia. The results indicated that farmers who received loans invested more in productive assets than the farmers who received FISP.

Further concluding that farmers who received credit showed some diversification attributes as they were spending more on livestock such as goats and pigs and crop production, unlike the farmers who accessed FISP. However, only private sector credit completed the credit focus of the study omitting government loans, which is a limitation. Furthermore, the study did not account for the endogeneity that arises from credit access, which might make the estimates biased. To correct for the problems of endogeneity in building up a subsequent study. This study employed an instrumental variable approach to ensure that the estimates are unbiased. Also, the study indicated that farmers who accessed loans had an income edge over those that obtained FISP, which made them more productive in agriculture. It leaves a gap that requires further clarification by not stating whether along with the farmer's productivity if dietary diversity was also influenced by the credit received. Thus, this study assessed the effects of credit access on dietary diversity to check if farmers' credit access can also improve their dietary diversity.

Furthermore, Sakala (2017) assessed the association between women's empowerment dimensions and child diet diversity among Zambian children aged 6 to 23 months old. The study utilized secondary data collected from the Zambia demographic health survey (ZDHS) covering 3136 children. It was targeting data collected from the years 2013 to 2014. The study employed multiple regression analysis. These results indicated that women empowerment programmes have a weak effect on child diet diversity and associated it with limited integration of child nutrition programmes and women empowerment programmes in Zambia. However, the study did not consider the effects of credit access on household dietary diversity, which formal empowerment that can relax a household's liquidity constraint (Annim and Frempong, 2018), which this study has considered in building on from prior studies.

Furthermore, Sakala (2017) used the dietary diversity scale of a range of 7 food groups. Such a scale is recommended by FAO to measure children's dietary diversity, but with a view of improving on this study. This paper utilized a dietary diversity scale that measures the household's dietary diversity based on a scale of 12 food groups.

In a subsequent study, Mukuka and Sambo (2019) analysed women's control over income, agricultural commercialization, and dietary diversity on rural households in Zambia. A study used an ordered probit model to analyse data from the Rural Agricultural Livelihoods survey of 2015 carried out by the Indaba Agricultural Policy Research Institute (IAPRI) covering 7,934

households. The results show that women's control over agricultural income has a significant positive effect on household dietary diversity. However, the study used a self-designed dietary diversity scale with four food group categories; (0 to 5), (6 to 8), (9 to 10), and (10 to 12) which do not show clearly from the distribution of dietary diversity at what point the household consumed from a medium level of dietary diversity. Thus, the study considered this challenge and used the FAO dietary diversity scale, which indicates several categories of dietary diversity; 0 to 4, 5 to 8, and 9 to 12 food groups showing clearly the household consumption at a low, medium, and high level of dietary diversity respectively. In this regard, previous studies have not explored the effects of credit access on dietary diversity in Zambia, as observed. Still, this association has been extensively investigated in other countries by several studies indicating varying results.

More specifically, Jalil (2015) used a multivariate Tobit model to analyse data from a sample of 400 households living in the Karanga district of Ghana. The data was collected using a multi-stage sampling design that allowed the study to estimate the association between credit and household food security. The results showed that access to credit has a significant positive effect on household dietary diversity in Ghana, concluding that households with a high amount of credit experienced an even higher level of dietary diversity. It indicates the possibility that access to credit improves a farmer's on-farm and off-farm activities through an increase in the household's income, allowing the family to improve its consumption and farm productivity, ultimately impacting their dietary diversity. However, the methodology used in this study does not account for endogeneity that results from credit access being a choice variable. And can lead to bias estimates in the model. In this regard, the study has employed an instrumental variable approach to correct endogeneity.

Furthermore, the results (Jalil, 2015) are similar to the findings in a study conducted by Annim and Frempong (2018), which utilized an instrumental variable approach to analyse data from the Ghana living standards survey collected from two waves of sample data covering 5779 and 8312 households. The results indicated that access to credit contributes positively to the consumption of diversified diets in Ghana because it relaxes the household's purchasing constraints and increases the household's productive capacity. Recommendations to create an environment in Ghana and elsewhere more conducive to micro-credit institutions' activities. By encouraging micro-credit institutions in rural areas through tax exemptions and financial support

systems. This study's significant gap is that (Annim and Frempong, 2018) employed the food consumption score (FCS) to measure dietary diversity. However, the FCS is not a reliable measure of dietary diversity because it measures dietary diversity of individuals based on the food consumed the past 7 days. There is a possibility that some respondents may not accurately remember the food they consumed the past 7 days. Thus, making the FCS measures very unreliable. Therefore, to estimate more reliable results in building on from these results, the study has used the HDDS to measure dietary diversity.

On the other hand, compared to (Jalil, 2015; and Annim and Frempong, 2018), Diagne (1998) analysed data from a three-round survey in 1995. It was covering 404 households in 45 villages in Malawi. The study used Ordinary Least Squares (OLS) to estimate the effects of informal and formal credit on food security. And found that access to credit has no significant impact on dietary diversity in Malawi. This study shows that access to credit does not improve dietary diversity in every country. Suggesting that the majority of the farmers preferred to finance their farming through internal sources (family/ relatives), and only a small population of smallholder farmers acquired funding from credit institutions. More specifically, the study's revealed that the use of collaterals significantly reduced smallholder farmers' access to credit. Still, the methodology in this study does not account for the endogeneity caused by credit access. And the OLS regression used does account for endogeneity. This study has employed an instrumental variable approach to correct for the endogeneity caused by credit access.

Furthermore, Diagne and Zeller (2001) utilized three rounds of survey data in 1995 from February to April in the first round. The second wave of data collection was from July to August. And finally, the last wave was from November to December. It was covering 4,699 households enumerated from 45 villages. Only 12 percent of the families participated in the village credit programmes showing meager credit participation from the data collected. The researcher used a purposive sample to avoid selecting respondents that were not in any credit programme. Still, purposively sampling respondents might expose the study to some degree of sampling bias. In this case, having observed meager credit participation, the researcher avoided sampling all respondents who were not participating in credit. Thus, the study has employed data collected using a stratified two-stage random sample to prevent the bias that comes with purposive sampling. In analysis, the study used a Two-Step Limited Information Maximum Likelihood Estimator and found that credit

access in Malawi has no significant impact on food security and nutrition consistent with the results found by (Diagne, 1998). The result might be because of short credit membership among smallholder farmers, which often lasts for 3 years. Smallholder farmers usually prefer to grow Tobacco instead of food crops to generate more income. Even with an increased income without nutritional education and market infrastructure, the potential of access to credit on food security and nutrition would still not be utilized. It is recommended that infrastructural resources in the social-economic environment be put in place for credit access to realize its full potential fully. Using credit access to improve the nutrition of smallholder, farmers may face challenges in a community that lacks irrigation and exhibits a lack of hard and soft infrastructural support. As a result, it is better to gradually introduce credit as these other factors are also being improved.

2.3.2 Other factors associated with dietary diversity

Mette and Havard (2014) established that consumption choices by the household are not always intuitive. Several factors might influence the consumer's consumption choice, as earlier discussed. And in this case, the following elements based on empirical literature can influence a smallholder household's consumption choice and dietary diversity; age, education, marital status, sex of the household head, residence, distance to an established agricultural market, access to agricultural advice, farm size, household size, and the farmer input support program (FISP).

2.3.2.1 Age of household head

Wasiu and Burhan (2017) analyzed the drivers of food security based on the perception among households in Southwestern Nigeria using a logistics regression model and data collected from 161 households in a multistage random sample. The study found that the head of a family's age had a significant favorable influence on the household's dietary diversity. Suggesting that the older the head of a household gets, the more experience they get to make more informed dietary decisions. It would have saved up enough income from working in the government and private sector, which allowed the household to purchase more varieties of food to improve the household's dietary diversity. However, this study employed an ordered probit model.

Contrasting prior studies, (Ngema et al., 2018) assessed the determinants of household food security status in South Africa (Maphumulo local municipality) using data collected from 495 households sampled using a stratified random sampling design and analyzed using a bivariate model. The study found no association between the age of the household head and household dietary diversity. However, this study employed an ordered probit model. Further contradicting earlier studies by (Wasiu and Burhan, 2017; and Ngema et al., 2018), (Habtamu et al., 2018) empirically analyzed; production diversification, dietary diversity, and consumption seasonality in Nigeria using unbalanced panel data collected from the Living Standards Measurement Study-Integrated surveys on Agriculture (LSMS-ISA) compiled by the World Bank in Nigeria. The survey captured two waves of survey data in the years 2010 and 2012. Using Random Effects estimation, the study found that the household head's age significantly reduced dietary diversity in Nigeria. It was attributing this to seasonal variations in crop production. These results indicate that it's not in every country that the household head's age improves dietary diversity, as earlier suggested when conceptualizing the study. The Random Effects model was used in the study to analyse panel data, but the subsequent study utilized cross-sectional data and employed cross-sectional methods of analysis.

2.3.2.2 Education level of household head

Simonette et al. (2014) employed data collected using a randomized controlled trial (RTC) study design from the Chilenje infant growth, nutrition, and infant study (CIGNS). Two locally produced infant foods, one porridge made from flour consisting of maize, beans, Bambara nuts, and groundnuts. One powder contained a basal and the other a productive level micronutrient fortification. Infants (n=743) aged six months randomly received either regime for 12 months. The primary outcome was stunting at age 18 months. No significant differences were seen between trial arms overall in proportion stunted at 18months. The study targeted Chilenje Township, a middle-income area in Lusaka, from 2005 to 2009, using multiple linear regression in line with education. The study found a high level of dietary diversity for infants at six months old in Chilenje with parents who had increased maternal education attainment. The result is attributing to the fact that educated parents had become more informed enough to make better decisions on child nutrition. However, in a township such as Chilenje, ensuring that all the infants undergoing the randomised trial do not eat anything else might be difficult or might require isolating these children

from their parents, which the study did not mention. And this is a limitation on the accuracy of the results (Simonette et al., 2014).

Similarly, Negash (2015) utilized a stratified random sampling technique and analyzed data covering a sample of 246 farming households in Akaki small-scale irrigation scheme in Ethiopia. The study aimed to develop the Heckman model of dietary diversity score using the two-stage model for analysis. The Heckman model is an ideal model when correcting sample selection bias (Briggs, 2004). Furthermore, studies by (Jalil, 2015; Negash, 2015) found that educated household heads have a probability of being rich in household dietary diversity. Consistent with Justus, Victor, Phillipo, and Thomas (2017), which analysed data collected using a multi-stage sampling design covering 204 respondents in Tanzania. The study employed OLS regression and found a positive probability of the household consuming at a higher dietary diversity if the head of the family had achieved at least six years of education.

In the same vein as prior studies, Ngema et al., (2018) utilized a stratified random sampling technique to collect data on a sample with 495 respondents in Maphumulo Local Municipality, South Africa. The study used a binary logistic model and found that education programmes receiving infrastructural support were positively influencing the household's dietary diversity. However, the logistic model is suitable for analysis when dealing with a binary dependent model that is not endogenous (Mukuka and Sambo, 2018 a). (Habtamu et al., 2018) Analyzed data from the Living Standards Measurement Study-Integrated Survey on Agriculture (LSMS-ISA). The study used a Random Effects model and found that the household head's education level significantly improved dietary diversity, but a random-effects model is a panel data estimation tool. In contrast, the study will use cross-sectional data.

Furthermore, Robert et al. (2019) examined data from 414 respondents in Nigeria collected using a combination of both purposive and randomized sampling techniques using an instrumental variable approach. The study found that educated household heads increased the pre-school children's dietary diversity, concluding that an educated household head is better informed to make decisions on the household's quality of food and diets. However, purposively sampling respondents allows the researcher to sample respondents that are relevant to the study. The most likely downside is that purposively sampling respondents increases sampling bias and does not

usually show a true reflection of the population's distribution (Robert et al., 2019). Whereas an instrumental variable approach in one of the best methodologies when correcting the effects of endogeneity. The most likely challenge occurs when the instrument does not satisfy all the conditions of a good instrument or is not available (Jeffrey, 2013).

On the other hand, in Zambia, Emmanuel Oladeji Alamu, Theresa Gondwe, Toluwalope Emmanuel Eyinla, and Busie Maziya – Dixon in 2019, conducted an assessment of dietary diversity of mothers and children of 6 – 24 months from eastern and southern provinces. The study found that education attainment of respondents was low. And this was affecting the household food selection decisions. In particular, most households had not completed primary school in Chipata, with only 19%, n=136 of the sampled population had completed primary school in Chipata. Whereas in Monze, only 8.7%, n=6, had completed primary school. And only 0.29% of the sampled population had completed university education in both Chipata and Monze. Also, a reflective position in which all households that had not completed primary is more likely to have missed out on secondary and tertiary education. Though, a few families managed to break this limitation and attained a tertiary level of education. With 11.43%, n=80, and 18.86%, n=132 of households in Chipata and Monze respectively completing secondary school.

At the same time, 8.43% and 1.29% of the interviewed households had no education attainment in Chipata and Monze, respectively (Emmanuel et al., 2019). The study employed a cross-sectional study design. Families with children 6 to 24 months were randomly selected, and if there was more than one mother or caregiver in the household, the senior-most became the household head. The study conducted a descriptive analysis of 400 sampled families (Emmanuel et al., 2019). However, it is not easy to know which household has children aged 6 to 24 months. It would have been better if the study employed a convenience sampling strategy. In this case, I saw that a random sample was likely to experience some level of sampling bias. These results further contrast the findings in the study by (Adebukola, 2017). which examined data on 250 respondents collected using a multi-stage sampling design in Iwo state Nigeria, using descriptive analysis, the study found that education level had no significant effect on dietary diversity. Contradicting the research by Robert et al. (2019) also conducted in Nigeria..

2.3.2.3 Marital status Of household head

Wasiu and Burhan (2017) analyzed data on 161 households from Southern Nigeria collected using a multi-stage random sample and estimated using a logistics regression. The study found that married families have a significant negative correlation with dietary diversity. Suggests that households headed by a married person are likely to have more people who might make it expensive to feed the household with a variety of daily food groups. Similar results (Otilia et al., 2017) conducted a study on dietary diversity in rural households and analysed data purposively sampled from 123 families in 38 communities from February to March 2015. Employing both a descriptive and discriminant analysis the study found that a 1unit increase in married houses significantly increased the household's consumption at a low level of dietary diversity. However, this study used an instrumental variable model.

On the other hand, (Adebukola, 2017) examined data collected using a multi-stage sampling design in Iwo state, Nigeria. The study covered 250 healthy adult women as respondents. It used descriptive analysis and found that marital status had a significant positive effect on dietary diversity. They attributed the results to the fact that young married women had a higher income and some education, which allowed them to make more informed decisions on dietary diversity and could afford to purchase more food groups. In a subsequent study, Ngema et al. (2018) utilized data on 495 respondents in Maphumulo Local Municipality, South Africa, and using a binary logistic model. The study found that married households respond better to improved dietary diversity as compared to their unmarried counterparts. They added that a married caregiver is more likely to put in an extra effort in the nutrition of the children and the household when making decisions regarding consumption and production. This study used a Variable Instrumental approach.

2.3.2.4 Sex of household head

meat, and fish is low for the whole study population. In a similar study, (Ngema et al., 2018) utilized data on 495 respondents in Maphumulo Local Municipality, South Africa. The study used Using a binary logistic model. The study found no significant association between the gender of the household head and household dietary diversity in Maphumulo. These results are consistent with the previously reviewed results in a study (Mukherjee et al., 2018). The results showed that

in both sampled populations, male-headed households were the minority, with females dominating as household heads. Most men had migrated to urban areas in search of better opportunities, and the female-headed households consumed almost the same food groups. However, Justus, Victor, Phillipo, and Thomas (2017) employed purposive sampling, while (Mukherjee et al., 2018) employed convenience sampling in the collection of data, but this study has used secondary data collected using a stratified two-stage sampling design (probability sampling method).

2.3.2.5 Residence (rural and urban)

The households location influences the household's ability to consume a diverse range of food groups and prior literatures have shown that households located in regions with more developed infrastructure are likely to consume more diverse foods as indicated in a study by Cock et al., (2013) which analysed data gathered across five districts using a two-stage stratified sample covering 599 households in rural Limpopo province. Using a multivariate analysis the study found that the rural part of the province had a significant negative association with dietary diversity and that households in the rural part of the province were experiencing a decrease in the level of dietary diversity. These results were attributed to the low education levels of households in the rural region. However, the study was based on a single province implying that these results cannot be generalized to make a conclusive decision on the current dietary diversity levels in the whole country.

In the same vein of results, (Kalle, 2016) analyzed data collected from the Demographic and Health Survey in Ethiopia covering 2,898 respondents and applied a non-linear decomposition model in analysis. The results indicated that households in urban areas of the country tend to have a higher dietary diversity as compared to those in rural areas. These results were attributed to the rural-urban gap existing in the households' dietary diversity levels which are mostly due to differences in household wealth, education level, and unequal access to healthcare in both regions. The results recommend a policy intervention to continue expanding rural provincial access to education and health care services. However, this study analyzed HDDS for children on a scale of 7 food groups while this study is based on HDDS covering a scale of 12 food groups. With an opposing view, (Mukherjee, et al., 2018) conducted a community-based study among the adult population in Durgapur, West Bengal in India and employed a convenience sample to collect data

from 216 adult participants. Using a multivariate logistics regression, the study found that households in rural areas consumed more diversified diets as compared to households in the urban region. Attributing these results to the fact that the price of food in rural areas is cheaper than in urban areas. The major downside to this study was that the researcher used a convenience sampling design.

2.3.2.6 Distance to an established agricultural market

Haruna and Shamim (2018) analyzed data collected using a primary survey of 900 households interviewed in Uganda. The study applied a random-effects model in analysis and found that the shorter the distance between the market and the farmer the higher the levels of dietary diversity in that area. Further suggesting that policies must be focused on enhancing farm production in areas closer to agricultural markets to enable households to access agricultural services more cheaply. Furthermore, Luitfred, Anja, and Ulrike (2018) analyzed data collected using a primary survey conducted on 900 sampled households in Tanzania. The study examined the implications of smallholder farm production diversity for household food consumption diversity. Employing a Poisson regression, the study found that promoting farm production diversification should consider the market access conditions because archiving an increased level of household dietary diversity may require effective market access infrastructure. However, Haruna and Shamim (2018) employed panel data regression tools, whereas this study has used cross-sectional methods of analysis. In a follow-up study, (Robert et al., 2019) employed both purposive and randomized sampling designs and utilized an instrumental variable approach in estimation. The study established that the household's closeness to the market improved pre-school children's dietary diversity and nutritional outcomes through improving access to the food market.

2.3.2.7 Off - farm income

Ngema et al. (2018) analyzed the determinants of household food security status and established that off-farm income negatively affects household dietary diversity in South Africa. It further suggested that for a unit increase in household income, households would less likely channel the income into improving their level of dietary diversity. It is because most families have less income due to the low income-generating opportunities in rural South Africa, restricting the household's participation in the food market. With an opposing view, Negash (2015) established

a theory for household dietary diversity using the Heckman model found that marginal changes in off-farm income increased the probability of been rich in dietary diversity.

In the same regard, (Demeke et al., 2017) linked farm diversification to household diet diversification in Kenya, utilizing data collected during the final wave of an evaluation of Kenya's cash transfer's welfare and economic impacts for orphans and vulnerable children (CT-OVC) covering 2,294 households. The study employed an ANOVA analysis and found that families with an off-farm income had a high level of dietary diversity. ANOVA is short for analysis of variance, it's a collection of statistical models and can be used to analyse the differences among group means in a sample (Steven, 2017). The ANOVA methodology's primary limitation is that it assumes that all groups in a sample have the same or similar standard deviations. In most cases, the higher the difference in standard deviations between groups, the higher the chance of the estimation been inaccurate (Steven, 2017). However, in analysing, the effects of off-farm income on dietary diversity, an Instrumental Variable approach was used.

In the same line of results, (Rahman and Mishra, 2018) conducted a study on the effects of non-farm income on food security in India. The study analysed longitudinal household data collected from the India Human Development Survey (HDS) conducted by the University of Maryland, USA, and the National Council of Applied Economic Research (NCAER) and covered 25,000 rural households from two waves of (2004-05 and 2011-12). The study used an instrumental variable approach and found that non-farm income from entrepreneurship and regular employment had a more significant impact on dietary diversity. It concluded that non-farm income plays a vital role in mitigating the risk of food poverty among poorer households. It establishes the relationship documented by the consumer theory that an increase in income allows the family to purchase more food groups.

2.3.2.8 Agricultural advice

Ragasa et al. (2016) assessed the impact of agricultural extension services on a heavily subsidized input support system in Malawi. The study used data from two waves of the integrated household panel survey (IHPS) from 2010 and 2013, covering a total of 12,271 households in the first wave. The second wave included a total of 3,246 households. The study used an instrumental variable approach in estimation. The results indicate that agricultural advice had no significant effect on

household dietary diversity. It was concluding that the quality of information was a relevant determiner of this association. However, this study employed cross-sectional data. With opposing results, (Therese et al., 2017) analyzed data collected using a mixed-method experimental design covering 12000 children under two years of age and 3000 pregnant women in Zambia. After applying descriptive analysis, the study found a strong positive association between training farmers on different agronomic practices and dietary diversity levels.

Further suggesting that training farmers and advising them on different agricultural practices is a great approach, especially that the Zambian education system makes little emphasis on agricultural diversification practices. The descriptive statistics used in this study is very useful in understanding the description of a variable, but if one of the variables is endogenous. Descriptive statistics may not be an ideal approach for research analysis on its own.

2.3.2.9 Farm size

Jalil (2015) analyzed data using a Tobit model. The results indicate that farm size has a significantly positive influence on the number of food groups that the household consumes, and this positively impacts the household's level of dietary diversity, implying that land is an essential determinant of household dietary diversity. In support of this study, (Justus, Victor, Phillipo, and Thomas, 2017) analyzed the determinants of dietary diversity in Tanzania and found that households owning large farm areas had a higher level of dietary diversity as compared to those with smaller farm areas. The study attributed it to the fact that most families in this region derive their income from agriculture, thus needing substantial pieces of land for the production of a variety of food groups. However, Justus, Victor, Phillipo, and Thomas (2017) employed OLS regression to analyze data.

On the other hand, (Ngema et al., 2018) analyzed the household food security status and its determinants in South Africa (Maphumulo local municipality) and found no significant association between the farm size and household dietary diversity. With similar results, (Habtamu et al., 2018) analyzed; production diversification, dietary diversity, and consumption seasonality in Nigeria using a Random Effects panel data estimation tool and also found no significant association between farm size and dietary diversity in Nigeria.

2.3.2.10 Household Size

Jalil (2015) found a significant positive effect between household family size and dietary diversity. The study implied that household size was directly or indirectly affecting a household's level of dietary diversity. In the same vein of results, (Habtamu et al., 2018) examined production diversification, dietary diversity, and consumption seasonality in Nigeria using a Random Effects panel data estimation tool and found that the larger the family size of the household the larger the household-level of dietary diversity. However, this study employed cross-sectional methods of analysis.

On the other hand, Ahmed et al. (2015) analyzed data collected using a multistage sampling technique from a total of 120 farming households and used a logit regression model in estimating the results. The study found a significant negative impact on the household size on dietary diversity and food security. The study attributed these results to the fact that food expenditure increases as the household size increases. And this negatively affects the household's dietary diversity. These results are supported by (Robert et al., 2019), who used a combination of purposive and randomized sampling techniques. The study utilized an instrumental variable approach. The results indicate that the size of a household has a significant negative effect on the household's dietary diversity, mostly attributed to the fact that families consist primarily of poorly educated smallholder farmers with poor access to electricity and water. The study indicates further worsening by the household's lack of knowledge of the importance of consuming food groups such as; eggs, meat, and other varieties of food, mostly preferring herbal concoctions, which negatively impacted the health and dietary diversity of the population in Nigeria.

With opposing results, (Mukherjee et al., 2018) conducted a community-based study among the adult populace in Durgapur and examined the determinants of dietary diversity. The study used the standardized dietary diversity questionnaire designed by the Food Agricultural Organization (FAO) and employed a convenience sampling technique where 216 participants are covered. In the analysis, the study used a multivariate logistics model and concluded that no significant association exists between household size and dietary diversity. However, (Mukherjee et al., 2018) employed convenience sampling. A Convenience sample is preferred in some studies, not just because it is easy to administer but also because it allows the researcher to obtain trends

regarding the survey. Without the complications of using a randomized sample, and it will enable the researcher to target a portion of the population that will suit the study best and conveniently. However, such a sampling strategy is very prong to sampling bias, and may not give a true reflection of the original distribution of a population. This study employed data collected using a probabilistic sampling design in the stratified two-stage random sample.

2.3.2.11 Farmer input support programme (FISP)

Studies by (Rodney, Jacob, Gerald, and Jayne, 2014; William, Jayne, and Nicholas, 2012; Magasu, 2016) established that the FISP was making little or no contribution to improving household's dietary diversity. The studies further suggested that the current FISP system suffers from high administrative costs. It is not entirely clear who the FISP targets and that the subsidized fertilizer and seeds may not be the best intervention for dietary diversity and farmer diversification for the poor. In the same vein of results, (Ragasa et al., 2016) conducted a study and examined the impact of agricultural extension services on a heavily subsidized input support system in Malawi utilizing panel data collected over two waves of the integrated household panel survey (IHPS) in 2010 and 2013 which covered a total of 12,271 households in the first wave and 3,246 households in the second wave. The study used an instrumental variable approach in analysis. The study confirmed that input subsidies had no significant effect on the household dietary diversity agreeing with the previously reviewed literature. A study by Juan and Jesus (2017) gave contradicting results after examining experimental research on the impact of policy interventions on dietary diversity. The results indicated that agricultural support programs had a significant positive impact on dietary diversity. However, studies by (Rodney, Jacob, Gerald, and Jayne, 2014; Magasu, 2016) were entirely qualitative. This study analyzed data on the effectiveness of FISP on dietary diversity using a quantitative approach.

2.4 Summary of literature review

Finally, the purpose of this review was to assist the reader better understand the different aspects posed by research on the effects of access to credit on dietary diversity and the other factors that influence the household's consumption choices or dietary diversity. Further explaining the relationships initially suggested by the conceptual framework in figure 2. The effects of credit access on dietary diversity are extensively reviewed by scholars in various countries and debated

upon because they continue to show varying results in each state. However, from the empirical literature, it has been observed that this relationship is unclear for Zambia. Therefore, there is a need to clarify this gap by examining how access to credit impacts dietary diversity in Zambia. An inquiry on this association is relevant to help Zambians live better healthier lives with improved nutrition status. Chapter three will discuss the methodology used in this study.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter discusses the methodology used in the study to achieve the research objectives. The study design, followed by Data source, Variable used in the study, data processing and Analysis, Theoretical model which tricked down to the Empirical models used in estimation, Ethical consideration, and Limitations of the study, and finally a summary of the chapter.

3.1 Study design

The study has used a quantitative approach because of the nature of the research problem. The secondary cross-sectional data used was collected from the 2015 Rural Agricultural Livelihood Survey (RALS) compiled by the Indaba Agricultural Policy Research Institute (IAPRI).

3.2 Data source

The Rural Agricultural Livelihood Survey (RALS) is a survey designed to obtain a comprehensive picture of Zambia's small and medium-scale farming sector in the ten provinces. The RALS contains variables that are of interest to the study. Including; sex, education, and age of the household head, province, residence (rural and urban), household size, farm size (hectares), off-farm income, marital status of the household head, access to agricultural credit, farmer input support program (FISP), loan society membership, the Headman/Headwoman's relation to the household head, distance to the nearest established agricultural market, and household dietary diversity.

Furthermore, the RALS 2015 used a stratified two-stage sampling frame. The sampling procedure started with identifying the primary sampling unit (PSU) in the first stage. PSU in this survey implied one or more standard enumeration areas (SEAs), which have a minimum of 30 agricultural households. The second stage of the sampling process involved listing and identifying

all agrarian families in the selected SEAs. The agricultural households grouped into three categories; A, B, and C based on the area under; crops, presence of some specified particular plants, number of cattle, goats, chickens raised, and sources of income. In the final stage, the study used systematic sampling to select 20 households distributed across the three strata in each SEA (Chapoto and Zulu, 2015). The RALS 2015 covered 476 SEAs across ten provinces, and a total of 7,934 households interviewed country-wide.

table 1 distribution of SEAs by province

Provinces	Total SEAs	Total Interviewed households
Central	42	650
Copperbelt	34	549
Eastern	117	2063
Luapula	42	692
Lusaka	26	446
Muchinga	43	717
Northern	50	791
Northwestern	32	516
Southern	52	893
Western	38	617
National	**476**	**7934**

Source: *RALS 2015 survey report from IAPRI.*

3.2.1 Variables used in the study

Household food consumption behaviour can be affected by many factors. However, this study identified twelve independent variables, chosen based on the literature reviewed. The variables include farmer access to credit, FISP, off-farm income, distance to an established agricultural market, farm size, residence, age of the household, education level, marital status, sex of the household head, and household size. A review of these variables starts with the dependent variable HDDS.

3.2.1.1 Dependent variable

Household Dietary Diversity Score (HDDS): measures the household's food consumption over a 24-hour recall period and is often used to reflect the household's access to a variety of food (food groups). HDDS is assessed based on 12 food groups; Cereals, roots and tubers, Vegetables, Fruits, Flesh foods, eggs, seafood, pulses/ legumes/ nuts, Dairy products, oil/ fats, sugar/ honey, and miscellaneous (FANTA, 2017). Which a household would have consumed the previous 24hours.

Furthermore, when calculating HDDS, each food group from the 12 food groups mentioned above is allocated a score "1" if the household consumed it the past 24hrs and "0" if the family did not consume the food group. The study then sums up the scores, as shown in equation (1), where the sum of all the food groups consumed is between 0 and 12. And are categorized into three groups:

- Low household dietary diversity, if the sum of all the food groups consumed is between 0 and 4.
- Medium household dietary diversity, if the sum of all the food groups consumed by the household is between 5 and 8.
- High household dietary diversity, if the sum of all food groups consumed is between 9-12 (Kennedy et al., 2013)

The rule is that an individual household's dietary diversity score must not exceed 12 (Kennedy et al., 2013). Because there are only 12 food groups, no single household consumes more than 12 food groups. More specifically, the study has adopted the FAO categorization of HDDS. It has categorized HDDS into three scores obtained from 12 food groups as earlier explained and the formula for calculating HDDS is as follows:

$$HDDS\ (0\ to\ 12) = sum\ (A + B + C + D + E + F + G + H + I + J + K + L) \ldots\ldots\ldots\ldots (1)$$

Where; A=Cereals, B=Roots and tubers, C= Vegetables, D=Fruits, E=meat, poultry and offal, F=Eggs, G=Fish and seafood, H=Pulses/ legumes/ nuts, I=Milk and milk products, J=oils/ fats, K=sugar/honey, and L=miscellaneous.

3.2.1.2 Independent Variables

Farmer access to credit: refers to the agricultural credit that smallholder farmers are receiving categorized as one (1) if the household has received any agricultural credit and 0 if the smallholder household has not received any agricultural credit. The RALS 2015 survey indicates several credit institutions responsible for the disbursement of loans to smallholder farmers countrywide. Including; Government, Commercial banks, ZNFU Lima Credit Scheme, Farmers' union or cooperative (excluding ZNFU Lima Credit Scheme), Microcredit institutions Out-grower scheme, Input credit from a private company (excluding out-grower schemes), NGO / faith-based organization/church, Friend/relative/informal money lender (e.g., kaloba), Company leasing equipment to own (e.g., Rent to Own), and Community-based savings group (e.g., SILC, VSLA, etc.) (Chapoto and Zulu, 2015).

Notably, each institution has different criteria that it uses to qualify smallholder farmers for credit access. For example, some Government-run programmes request land titles as collateral to cover the risk of lending to the smallholder farmers (Chapoto and Zulu, 2015). At the same time, Farmers' unions and cooperatives will mostly lend to smallholder farmers who are members of these groups (Chapoto and Zulu, 2015). Generally, the qualifying criteria vary for each lending institution. Access to credit is one of the most significant factors in household food diversity, enhancing the household's dietary diversity. Credit access and its role in relaxing a smallholder's liquidity constraint and food diversity. Although some studies like (Diagne and Zeller, 2001; Diagne, 1998) indicated that credit access does not play a significant role in Malawi. However, it is possible that for Zambia, credit access might play a vital role in enhancing household dietary diversity.

Finally, social demographic and economic factors such as; Age of the household head, in years a continuous variable indicates how long the head of a household has lived. Age is one of the factors that reflect growth in a person's life. For example, an increase in age can also symbolize growth in a person's income, encouraging the person to consume more diversified diets (Wasiu and Burhan, 2017). In comparison, age can also imply an increase in an individual's knowledge and understanding. Motivating individuals to make better decisions on food consumption and nutrition (Wasiu and Burhan, 2017).

Sex of the household head, which can either be male or female, has been categorised as '1' if the household head is male and '0' if the head is female. There is one primary reason why the sex of the household head is in the study. Mostly, as a result of a study by (Jalil, 2015). The study established that sex has a significant bearing on household views and approaches to dietary diversity, with female heads seen to be more nutritious cautious, especially that they look after the wellbeing of the household and are mostly concerned with the children's nutrition.

At the same time, Household size implies the number of members in a family estimated as a continuous variable. A large household can help the smallholder household directly impacting the amount of labour used for food production. Though the size of a family can be problematic, it raises the costs incurred to consume at a given level of dietary diversity. In the same vein, several researchers have attempted to assess household size (Jalil, 2015; Ahmed et al., 2015; Mukherjee et al., 2018). Though with conflicting results, studies found the household size to be a significant determinant of household dietary diversity. Whereas in Zambia, the role that the household size plays in household food consumption exploited.

Agricultural advice accounts for any information on farming practices that smallholder farming households received. Categorized as one (1), if the family received agricultural advice and 0 for the smallholder households did not receive any agrarian advice. Agricultural information in Zambia contributes to disseminating knowledge and skills on food production and diversity. With these attributes, agricultural advice investigated in numerous studies (Ragasa et al., 2016; Therese et al., 2017) showed the importance of agrarian advice to smallholder farmers because of its contribution to food production. Thus, emphasizing the need to be considered in most studies attempting to assess the determinants of dietary diversity.

The household head's education level indicates the number of years the household head has spent in formal education, be it at a primary, secondary or tertiary level. The variable also notes down whether the household head has not attained any formal education. The household head's education level is categorized as; '0' if the household head has no formal education, '1' if the household head has spent (1 to 7) years in formal education at a primary level. '2' if the household head has attained up to 12 years of formal education from grade (8 to 12) at a secondary level. And for household heads that have attained more than 12 years of formal education at a tertiary level. The study has categorised as '3' for a household head who has reached 13 and above years

of formal education at a tertiary level. Education attainment is one of the most critical factors in food diversity determination. It is because it allows an individual to learn more about food and nutrition, thus making an informed decision regarding the dietary diversity of a household. Seeing the vital role education plays in food diversity determination as observed in reviewed pieces of literature like (Simonette et al., 2014; Negash, 2015; and Robert et al., 2019). It is highlighting the significance of education attainment.

Furthermore, household heads in a marital union (Marital Status of the household head) and those that have never been married are being categorized as; '0' if never married for 'single', '1' for cohabiting, '2' for monogamously married, '3' for polygamous marriage, '4' for separated, '5' for divorce, and '6' if the widowed household head. For simplicity purposes, in regression, marital status has been presented as '1' for a married household head and '0' for otherwise. Studies like (Adebukola, 2017) have established that marriage can significantly cause most households to improve their nutritional level. Because it creates an atmosphere for a shared dietary effort, this makes it an essential factor to consider in food diversity determination.

FISP in this study identifies farmer input support that smallholder households receive from the government in the form of seeds and fertilizer (Chapoto and Zulu, 2015). The study would categorize FISP as '1' if the smallholder household received input support and '0' for smallholder households that did not receive any input support. The choice to include this variable in the study was motivated by the high social benefits. Although several studies like (Rodney, Jacob, Gerald, and Jayne, 2014; William, Jayne, and Nicholas, 2012; Magasu, 2016) established that FISP was not contributing to dietary diversity using qualitative methods. A quantitative approach was necessary to conclude the significance of FISP on household dietary diversity and nutrition in Zambia.

The distance showed the smallholder farmer's food access in the study to an established agricultural market. Ideally, the distance from the smallholder farmer's household to a meeting place where you find buyers and sellers of farm produce generally highlights the household's access to a variety of food groups. And this variable measured in kilometres (km) indicates the smallholder household's market access conditions. Thus, it was considered one of the significant determinants of household dietary diversity in this study, having observed its relevancy in previously reviewed literature (Luitfred, Anja, and Ulrike, 2018).

Furthermore, income earned by the household in the form of wage or salary from activities off their farm such as; working on a commercial farm, working in the civil service, working in a private company, receiving a pension, working as a maid, working in a mine, allowances from volunteering, working as a bus driver, bricklaying, compensation, and by other off-farm activities (Chapoto and Zulu, 2015). Based on the consumer theory reviewed by (Levin and Milgrom, 2004), income is a significant determinant of household dietary diversity. Making income a critical factor in this study and was considered for analysis. Several studies that included income the determination of household dietary diversity. Reviews like (Negash, 2015; Demeke et al., 2017). The study categorized Off-farm income of smallholder households as '1' if the family earned an off-farm income and '0' for households with no off-farm income.

Farm size is likely also to influence the variety and quantity of food groups consumed by the household. As observed in prior studies (Jalil, 2015; Justus, Victor, Phillipo, and Thomas, 2017), it acknowledged the importance of farm size in dietary diversity determination. The study has measured farm size by the land area that smallholder households own and cultivate measured in hectares (Ha).

Production and consumption conditions are likely to vary depending on the residential conditions in each location. Therefore, the study accounted for residential variations by measuring dietary diversity in each residence. Having observed from several studies (Kalle, 2016; Mukherjee et al., 2018). Dietary diversity is not the same in each region. Households in certain areas are likely to consume more diversified diets as compared to other areas. Several pieces of literature having established in different countries and created the basis for policy assessment in the Zambian context. The variable residence categorized as either '1' for rural and '0' for urban homes. Table 2 below summarizes the above variables.

table 2 definition, description, apriori, and prior studies of the variables.

No.	VARIABLE	DESCRIPTION	APRIORI (+/−)
1	HDDS	Household dietary diversity was classified as follows: Low household dietary diversity (0 to 4) food groups, medium household dietary diversity (5 to 8) food groups), and high household's dietary diversity (9 to 12) food groups	N/A
		INDEPENDENT VARIABLES	
2	Access to credit	Dummy for credit received = 1, and otherwise = 0.	+
3	Access to agricultural advice	Dummy if the farmer had received agricultural advice = 1, and otherwise = 0.	+
4	FISP	Dummy for farmers who received FISP = 1, and otherwise = 0.	−
5	off - farm Income	Dummy if household received off-farm income= 1, and otherwise = 0.	−
6	Distance to an agricultural market.	Distance in Kilometres (Km)	−
7	Farm size	Farm size in hectares (ha)	+
8	Residence	Dummy for residence in Zambia: Rural=1, and Urban=0	+
9	Age of HHD	Age of household head in years (continuous values)	+
10	Education level	Category of the household head's highest education level attained: (less than 1 year) =0 No Education, Primary (1- 7 year) =1, Secondary (8 – 12year) =2, and Tertiary (13 years and above) =3.	+
11	Marital status	Dummy for the marital status of the head of the household: 1 = Married and 0 = Otherwise	−
12	Sex of HHD	Sex of head of household: 1 = Male and 0 = Female	+
13	Household Size	Size of households (continuous values)	+
		INSTRUMENTAL VARIABLES	
14	Loan Society membership	Dummy if anyone in the household is a member of a savings or loan society: 1 = Yes and 0 = otherwise.	N/A
15	Headman/woman's relationship with the household head	Dummy if the household head is related the Headman/ Headwoman: 1 = Yes, 0 = otherwise.	N/A

3.3 The empirical model

3.3.1 Instrumental variable approach

In light of the theoretical model earlier explained, smallholder farmer participation in dietary diversity can be expressed algebraically in equation (2) where the household's dietary diversity is dependent on; K_i = Credit access, Z_i = Farm size, ρ = a vector capturing smallholder household characteristics or social demographic and economic characteristics, D_i = distance to an established agricultural market and ε = the random error term.

$$HDDS_i = (K, Z, \rho, D) + \varepsilon \ldots\ldots\ldots\ldots (2)$$

However, access to credit is a choice variable and is likely to be endogenous. Meaning that credit access is associated with the error term in the model, which can affect the association of credit access on dietary diversity leading to bias estimates (Jeffrey, 2013). Therefore, to account for endogeneity in credit access, the study uses an instrumental variable (IV) approach. For IV to be valid, three conditions are necessary:

1. The instrument must be randomly assigned or as good as a random occurrence.
2. The exclusion restriction must be satisfied, where the instrument is correlated with the endogenous variable, but not directly related to the outcome variable dietary diversity.
3. The instrument must not be related to the error term (Damon, 201).

The IV approach used in the study has taken a two-stage method to address endogeneity. In the first stage, the study regressed the instruments and the other covariates like age, sex, residence, marital status, FISP, family size, farm size, and agricultural advice on the treatment credit access. In the second stage, credit access and the other covariates earlier mentioned were regressed on the outcome HDDS completing the instrumental variable analysis. Mainly, to successfully apply the IV approach, the study first needed to identify one or more variables strongly correlated with credit access and not directly related to dietary diversity unless through credit access. Based on the mentioned criteria, the study used two instrumental variables: Loan society membership and the Headman/Headwoman's relationship with the household head.

The two instruments are ideal because (i) membership in a Loan society gives the household access to cheap loans and easy access to liquidity during hard times. The organization tries to improve the economic and social conditions of its members. As a result, it increases credit

participation among households (Ezekiel and Sheriff, 2018). And through the credit accessed, the family can purchase better inputs and food to consume higher dietary diversity (Brunie et al., 2014). Thus, the loan society membership impacts dietary diversity indirectly through credit access, fulfilling the exclusion restriction.

The second instrument (ii) 'Headman/Headwoman's relationship with the household head' according to (Straub and Ronnas, 2001) having close relations with the village leaders can significantly influence credit participation. Several credit programmes that are being initiated in the rural residences to empower smallholder farmers might suffer drawbacks. Some farmers that borrow are unable to fully repay their debt, which defeats the purpose of recycling the credit among the smallholder farmers. Still, ensuring smallholder farmers can repay their loans. Village headmen/Headwomen are involved in the credit schemes to help identify honest farmers with the capacity to repay debt.

In most cases, the village headmen/head women are likely to choose farmers who are close to them, whom they trust to repay the loan. In the end, it can have a significant impact on credit access and household dietary diversity. It implies that having close relations with the village headman/headwoman can directly impact the household's credit participation and indirectly their dietary diversity through credit access. Therefore, fulfilling the exclusion restriction. And both instruments are a random occurrence. Thus fulfill the first and second condition of a valid instrument.

Furthermore, the last requirement of an instrument's validity states that an instrument must not be related to the error term tested for in the first-stage regression. The study used estimation tests like the joint F-statistic (Fisher, 2010), the Cragg-Donald Wald and Stock-Yogo weak ID test, the Anderson-Robin Wald test, Stock-Wright LM test (Mayoral, 2015), and Sargan test (Nunez, 2008). In particular, the joint F-statistic (Fisher, 2010), and Cragg-Donald Wald and Stock-Yogo tests assessed the instruments' strength and whether the instrument was related to the error term in the model (Mayoral, 2015). Whereas the Anderson-Robin Wald test checked the relevance of the endogenous variable (Mayoral, 2015). And the Sargan test assesses whether the over-identification restrictions used in the model are valid or in simple terms if the use of instruments is correct in this case (Nunez, 2008).

First stage estimation:

$$Credit\ Access\ (\widehat{K}) = \alpha + \beta_2 \sum A_i' + \beta_3 \sum Z_i + \beta_4 \sum \rho_i + \beta_5 \sum D_i + \varepsilon_1 \ldots\ldots\ldots\ldots\ldots (3)$$

Where:
$K, Z, \rho, D, \varepsilon$ = are as defined earlier
A_i'= is the vector for instrumental variables for farmer access to credit
K =The endogenous variable (farmer access to credit).
$\alpha, \beta_2, \beta_3, \beta_4, \ \beta_5$ = are the coefficients estimated.

Second stage estimation:

The second stage corresponds to the estimation of the impact of smallholder farmer access to credit on household dietary diversity, for this purpose the following equation was estimated:

$$HDDS_i = \varphi + \gamma_2 \sum \widehat{K}_\iota + \gamma_3 \sum Z_i + \gamma_4 \sum \rho_i + \gamma_5 \sum D_i + \varepsilon_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where:
$K, Z, \rho, D, \varepsilon$ = are as defined earlier
$\widehat{K}_\iota$=The instrumented variable (smallholder farmer access to credit)
$\varphi, \gamma_2, \gamma_3, \gamma_4, \gamma_5$ = are the coefficients estimated.

3.4 Ethical consideration

The Ethics Committee at the University of Zambia approved the study protocol on secondary data collected from the Rural Agricultural Livelihood Survey (RALS) of 2015 compiled by the Indaba Agricultural Policy Research Institutes (IAPRI), and all respondents gave their consent before participating in the survey.

3.5 Limitations of the study

The absence of data on dietary diversity in earlier surveys hampered a thorough analysis that could have allowed the researcher to conduct the study over two or more years. Such a study would have helped explain how credit been accessed by smallholder farmers over time impacts dietary diversity in Zambia. Still, because data on dietary diversity was only available in the RALS 2015 dataset, the study employed cross-sectional methods of analysis. Inhibiting the study from concluding the long-term effects of farmer credit access on dietary diversity as this would have been possible if the study used a panel data method of analysis.

3.6 Summary of methodology

Finally, this chapter described the research methodology and the ethical consideration. Chapter 4 presents the data analysis and interpretation of the findings.

CHAPTER FOUR

RESULTS AND DISCUSSION

The previous chapter discussed the methodology. However, this chapter presents the study findings starting with; descriptive statistics, empirical results, and a discussion on the study findings.

4.1Descriptive statistics

table 3 descriptive statistics

Variable	Observations	Mean	Std Dev.	Min	Max
Household Dietary Diversity Score (HDDS)	7698	.843	.605	0	2
Agricultural Advice (0= No, 1= Yes)	7698	.819	.385	0	1
Education Level of the household head (0= None, 1=Primary, 2=Secondary, 3=Tertiary)	7698	1.21	.705	0	3
Marital Status of the household head (0=Otherwise, 1= Married)	7,698	.989	.106	0	1
Sex of the household head (0= Female, 1=Male)	7698	.789	.408	0	1
Household size	7698	4.066	2.008	1	18
Farmer Input support (FISP) (0=No, 1= Yes)	7698	.277	.448	0	1
Age of the household head (Years)	7698	48.589	14.811	16	105
Distance to an established agricultural market (km)	7698	24.884	30.605	0	300
Residence (0= Urban, 1= Rural)	7,698	.940	.237	0	1
Off- farm income (0= No, 1= Yes)	7698	.294	.456	0	1
Credit Access (0= No, 1= Yes)	7698	.192	.394	0	1
Loan Society Membership (0= No, 1= Yes)	7,698	.062	.241	0	1
Headman/Headwoman's relationship with the household head (0= Otherwise, 1= Yes)	7,698	.486	.500	0	1
Farm Size (Ha)	7698	2.288	2.496	.01	66.265

Source: *Author, computed from RALS 2015 survey data.*

Table 3 provides information about the variables of interest in the dataset. It indicates the mean and standard deviation statistics on the data distribution and the minimum and maximum values. The standard deviation (SD) is an indicator of how spread out the data is about its mean (Danish, 2017). A high SD means data is widely spread out over a range of values. And a smaller SD implies that the data is not widely spread and is closer to its mean. Although, it is not easy to determine at what point the SD is considered high or low. To learn how too spread out data is about the mean, the study used the Coefficient of Variation (CV), which is measured by dividing the SD by the mean, the rule of thumb is that if (CV>1), then the SD is high. And if (CV<1), then the SD is low (Danish, 2017).

In this regard, Household Dietary Diversity Score (HDDS) coded as 0/2 with the mean representing the high level of HDDS at 0.843. And a standard deviation (SD) of 0.605. It indicated that the data points on HDDS are close to the mean. And that the majority of smallholder households interviewed consumed closer to the high level of HDDS. Similarly, Agricultural advise coded as 0/1, with a mean representing the households that accessed agricultural advice at 0.819. And a standard deviation of 0.385. Also had the majority of families accessing agricultural advice with the data points close to the mean. Education level coded as 0/3, with a mean representing tertiary education at 1.21. And a standard deviation of 0.705. It also indicated a spread of data points close to the mean, with a low standard deviation. It also implies that the majority of households are not far from attaining a tertiary level of education. Marital status coded as 0/1. With mean representing married households equal to 0.989. And a standard deviation of 0.106. similar to previous statistics. This variable also had a low standard deviation. It was indicating that most families interviewed were close to being married.

Sex of the household head coded as 0/1. With mean representing the male head at 0.789. with a standard deviation of 0.408. It also indicated a lower deviation of data points about the mean. It was implying that most household heads interviewed were male. Household size a continuous variable with mean representing households with close to 18 members at 4.066. And a standard deviation of 2.008. with maximum and minimum values from 1 to 18, respectively.

Similarly, the low SD for household size indicates that the spread of households further from 18 members was low. Most families had a member's closers to the mean. Furthermore, FISP

a dummy variable coded as 0/1. With a mean indicating households that accessed FISP at 0.277. And a standard deviation of 0.44. the low SD indicates poor household participation in FISP. With the number of outliers about the mean high. Age of the head a continuous variable with values from 16 to 105. And a mean value of 48.589 representing households with age closer to 105. With an SD of 14.811. the low SD shows that majority of heads interviewed had age closer to the maximum age 105. Not many household heads deviated too far from the maximum age of the households 105. Distance to an established agricultural market, a continuous variable with a maximum value of 300km. With a mean representing households who live 300km from an agrarian market at 24.884. And a standard deviation of 30.605. On the other hand, the high standard deviation indicates that most households included in the survey lived closer to an established agricultural market. As the deviation of outliers was further from the mean.

Residence coded as 0/1, with the mean representing rural areas at 0.940. And the standard deviation of 0.237. the low standard deviation indicates that the majority of smallholder households interviewed were from rural areas. As the deviation of data points was closer to the mean values. Off-farm income coded as 0/1, with a mean indicating households that earned an off-farm income at 0.29. And a standard deviation of 0.456. The high SD suggests that most households surveyed did not receive an off-farm income. As observed from the high variations of data point further from the mean.

Similarly, access to credit coded as 0/1, with a mean representing the proportion of households who accessed credit at 0.192. And a standard deviation of 0.394. indicated that very few families interviewed had obtained agricultural credit. The high SD showed that most outliers in the dataset were further away from the mean representing credit. Loan society membership coded as 0/1, with a mean indicating households who are members of a loan society at 0.062 and a standard deviation of 0.241.

Similarly, the high SD showed that very few households interviewed belonged to a loan society. In the same vein, the headman/ head woman's relationship to the household head coded as 0/1. A mean value of 0.486 represents the households whose head was related to the headman/headwoman. A standard deviation of 0.500 indicated a high CV Showing that very few households were related to the headman/headwoman. As observed from the spaced data points

about the mean, finally, farm size a continuous variable with a mean of 2.288. And a standard deviation of 2.496, demonstrated similar results to earlier reviewed statistics. Showing a high SD, which implied that most households interviewed cultivated on small pieces of land. As observed from the deviations of data points about the mean represented by the maximum farm size 66.265Ha, the next section explains further the descriptive statistics of the main variables. The part Starts with HDDS then credit access.

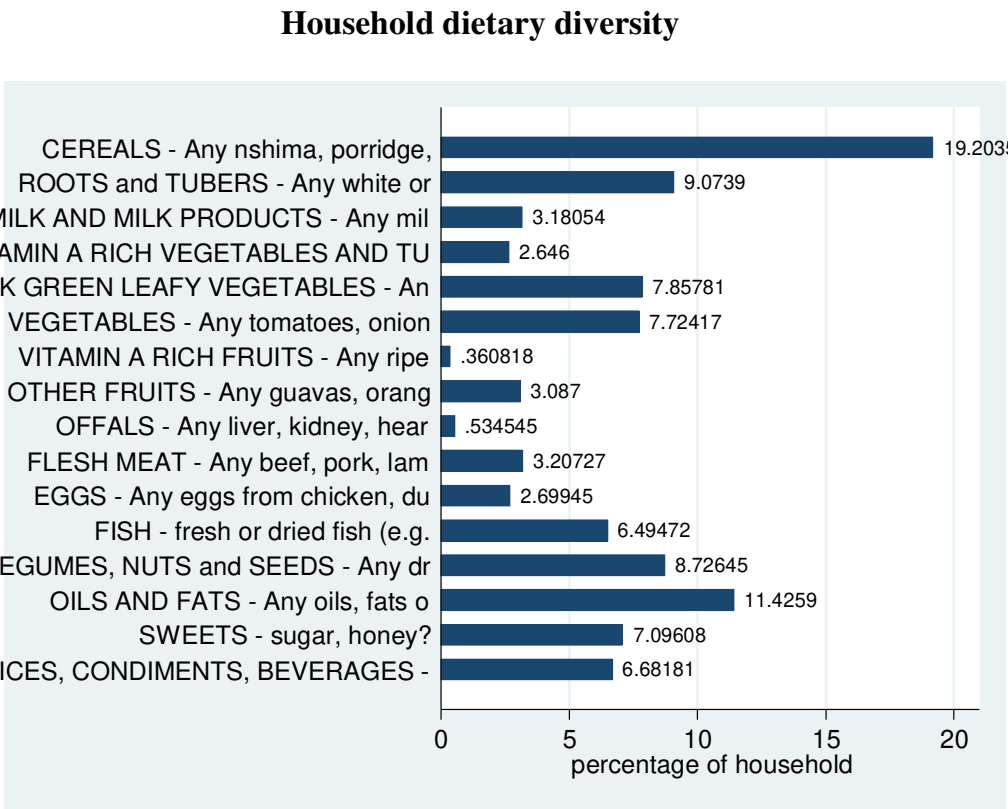

figure 3 percentage of food group consumption per household

Source: *Author, computed from RALS 2015 survey data.*

Figure 3 shows that about 19.02% of smallholder households reported having been consuming mostly cereals. However, the consumption of other food groups is patchy, suggesting low use of these food groups within Zambia families. The study now turns to the HDDS categorization below. To gain a better understanding of Zambia's HDDS.

table 4 distribution of HDDS

Residents	Low HDDS(0-4)	Medium HDDS(5-8)	High HDDS(9-12)
Distribution of HDDS in the rural areas	1962	4410	867
Distribution of HDDS in the rural by percentage (%)	27.10	60.92	11.98
Distribution of HDDS in the urban	147	278	34
Distribution of HDDS in the urban area by percentage (%)	32.03	60.57	7.41
Population distribution of HDDS	2109	4688	901
Population distribution of HDDS by percentage (%)	27.40	60.90	11.70

Source: *Author, computed from RALS 2015 survey data.*

Table 4 shows that households in rural and urban residences consume mostly at a low and medium level of dietary diversity, with only a small percentage consuming at a high level of dietary diversity. In particular, approximately 27.10% and 60.92% of the smallholder farming households in rural areas consume eight or fewer food groups daily. At the same time, 32.03% and 60.57% of the smallholder farming households in urban areas consume eight or fewer food groups, respectively. And from the population of smallholder farming households in Zambia, only 11.98% and 7.41% of smallholder households consume more than eight food groups daily in the rural and urban residences. Furthermore, figure 4 below shows that on average, smallholder households in Zambia are consuming six (6) food groups daily.

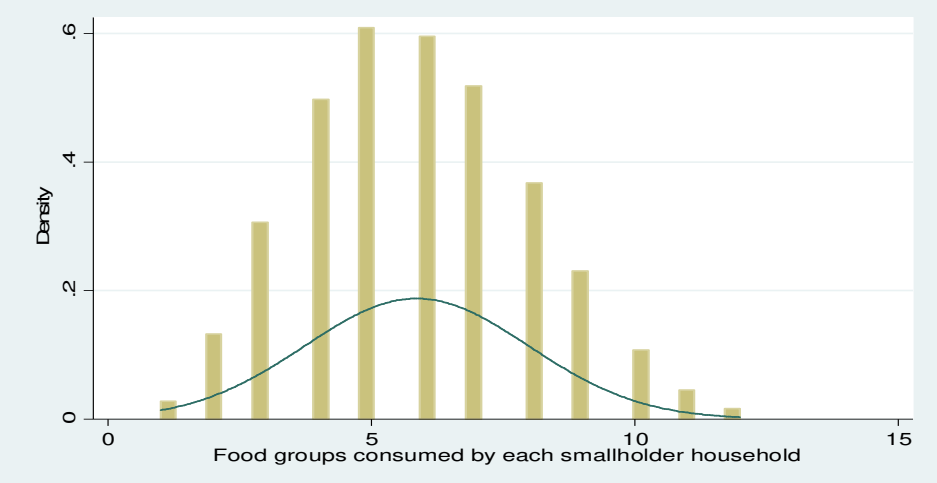

figure 4 distribution of food group consumption

Source: *Author, computed from RALS 2015 survey data.*

Note: *the line curve indicates the Kernel Density. It allows the study to inference about the overal population behaviour regarding HDDS based on the sample data.*

4.1.1 Smallholder farmer credit access

table 5 household credit access by residence.

Residence	Non – credit participants	Credit Participants
Distribution of credit and non - credit participants in the rural	5811	1428
Percentage (%) of rural participation	80.27	19.73
Distribution of credit and non – credit participants in the urban area	412	47
Percentage (%) of urban participation	89.76	10.24
Population of credit and non- credit participants	6223	1475
Percentage (%) of national participation in credit	80.84	19.16

Source: *Author, computed from RALS 2015 survey data.*

Table 5 indicates poor credit participation in Zambia among smallholder farming households, with about 10.24% of the smallholder farmers in urban areas reporting to have accessed agricultural credit. However, the proportion of credit access was higher in the country's rural residence, with approximately 19.73% of the smallholder farming households participating in agricultural credit. Thus, giving a national average of 19.16% of smallholder farming households accessing agricultural loans. Figure 4 shows that out-grower schemes remain one of the most crucial credit sources, with more than 50% of smallholder households agreeing to obtain credit from out-grower programmes and friends and relatives (Kaloba).

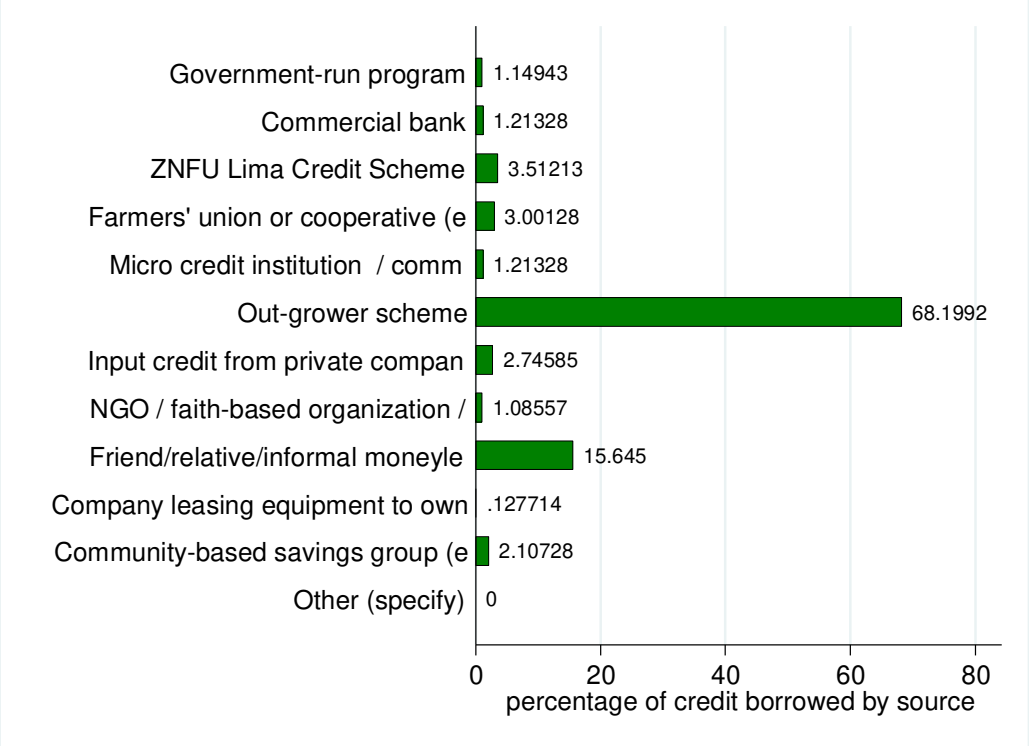

figure 5 agricultural credit distribution by source

Source: *Author, computed from RALS 2015 survey data.*

Figure 5 indicates that though credit participation among smallholder households is low, the majority of the smallholder farmers have maintained faith in credit from out-grower schemes. The study estimated that 68.2% of the financed smallholder farmers reported having accessed credit

through the schemes. The second notable source of credit was through friends/family (Kaloba) and other informal money lenders at 15.65%. The remaining credit sources accounted for 13.89% of the smallholder farmers who accessed credit. And the actual loan disbursements by source are shown in figure 6.

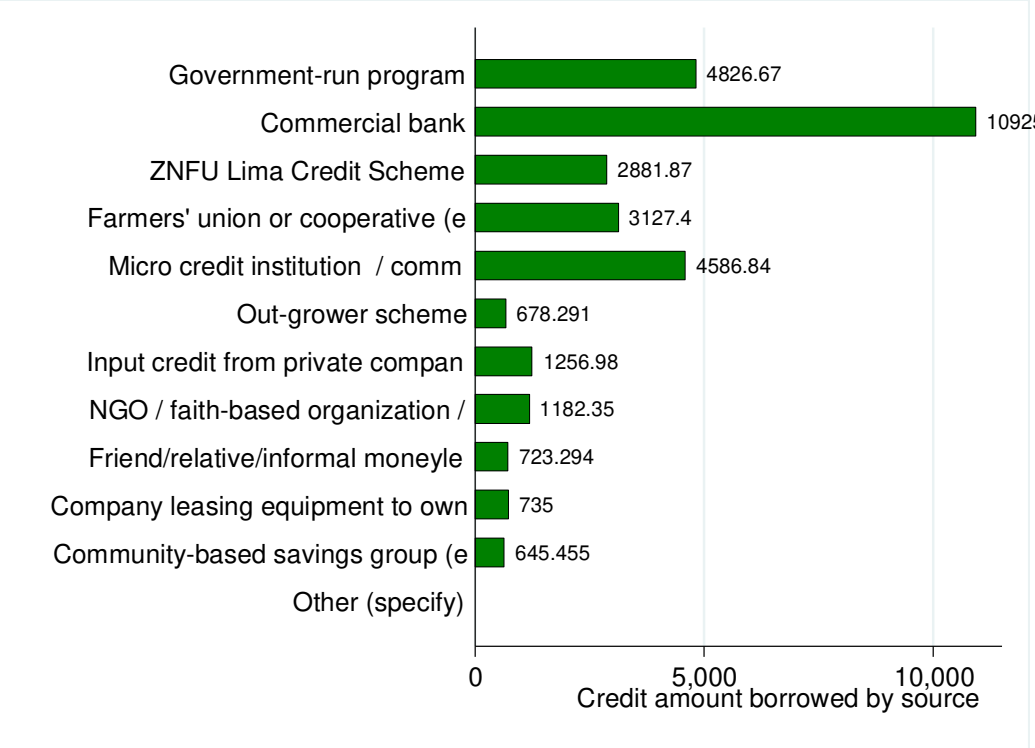

figure 6 agricultural credit amount by source

Source: *Author, computed from RALS 2015 survey data.*

Figure 6 shows that though credit participation in commercial banks was low at 1.2% as indicated in Figure 5, they disbursed the most substantial value of loans to smallholder farmers at K10925.7. The second-largest disbursements came from government-run programs at K4826.67, which is slightly above the total loan value disbursed by a microcredit institution at K4586.84. However, loaning money/credit is a risky business. Most money lenders will require some security before entrusting a farmer with their money, which is usually in the form of; collateral, movable or immovable assets, as shown in figure 7.

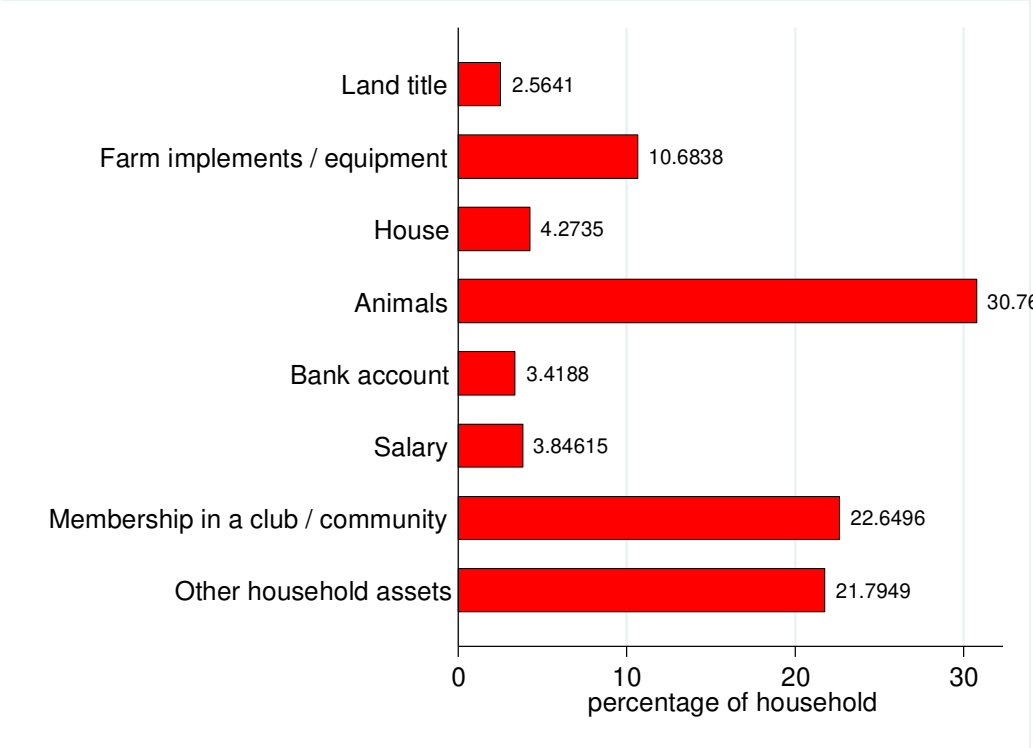

figure 7 collateral distribution by household

Source: *Author, computed from RALS 2015 survey data.*

Figure 7 indicates that most smallholder households felt comfortable using animals as collateral for credit, with about 30.8% of smallholders decided to use animals. Smallholder farmers who had membership in a club or community were able to borrow using their membership, and about 22.649% of smallholder farmers belonged to a club or society. However, table 6 shows that every money lender accepts not all types of collateral. Out-grower schemes frequently requested guarantee in the form of animals, membership in a club or community-based savings group, and household assets. Whereas, the most common collateral required among all the money lenders is farm implements, membership in a club or community-based savings group, animals (livestock), and household assets. However, a portion of households used in the study accessed credit without using any form of collateral. Whereas in some instances missing information prevented further assessment of the collateral used to access credit.

table 6 money lenders and collateral

Money Lenders and Collateral									
	Land title	Farm implements / equipment	House	Animals	Bank account	Salary	Membership in a club / community group / cooperative	Other household assets	Total
Government-run program	1	1	1	0	0	1	0	0	4
Commercial bank	1	0	2	0	4	3	0	2	12
ZNFU Lima Credit Scheme	0	3	0	7	1	0	10	1	22
Farmers' union or cooperative (excluding ZNFU Lima Credit Scheme)	0	2	0	4	0	0	3	1	10
Micro credit institution / community credit scheme	1	0	0	1	1	4	2	2	11
Out-grower scheme	3	7	6	47	1	0	31	28	123
Input credit from private company (excluding out-grower schemes)	0	2	0	4	0	1	1	2	10
NGO / faith-based organization / church	0	0	1	2	1	0	1	1	6
Friend/relative/informal moneylender (e.g., kaloba)	0	8	0	6	0	0	1	13	28
Company leasing equipment to own (e.g. Rent to Own)	0	1	0	1	0	0	0	0	2
Community-based savings group (e.g., SILC, VSLA, etc.)	0	1	0	0	0	0	4	1	6
Total	6	25	10	72	8	9	53	51	234

Source: *Author, computed from RALS 2015 survey data*

4.1.1 Association between access to credit and dietary diversity.

table 7 tabulation of credit access and HDDS

Credit Access	Low HDDS (0-4)	Medium HDDS (5-8)	High HDDS (9-12)
Distribution of HDDS for non- Credit Participants	1730	3794	699
Percentage (%) of HDDS for non – credit participants	27.80	60.97	11.23
Distribution of HDDS for credit participants	379	894	202
Percentage (%) of HDDS for credit participants	25.69	60.61	13.69
Population distribution of HDDS participation	2109	4688	901
Percentage (%) of population HDDS participation	27.40	60.90	11.70

First row has *frequencies* and second row has *row percentages*
Source: *Author, computed from RALS 2015 survey data*

In summary, table 7 indicates that the majority of households consumed at a medium level of HDDS. However, it is also clear that a higher percentage of households access credit consumed at a high level of HDDS as compared to otherwise. The results in table 7 do not conclusively explain if the increase in dietary diversity was due to the households accessing credit, seeing that the difference in dietary variety between families that obtained credit and those that didn't is quite small. Thus the need for an in-depth empirical analysis as shown in the next section.

4.2Regression results

Furthermore, tables 8 and 9 present the empirical results of the study findings from an instrumental variable approach which indicates that the model fits this type of regression at a 1% level of significance and is a good model.

table 8 first-stage IV regression of credit access

Credit Access	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Loan Society Membership	.0522099	.0183204	2.85	0.004	.016297	.0881229	***
Headman /Headwoman's relation to the HHD	.0786956	.008964	8.78	0.000	.0611237	.0962676	***
Agricultural advice	.1324324	.0115077	11.51	0.000	.1098741	.1549907	***
Education HHD							
1. Primary	.0338399	.0174876	1.94	0.053	-.0004407	.0681205	*
2. Secondary	.0319072	.0301814	1.06	0.290	-.0272566	.091071	
3. Tertiary	.0552406	.048405	1.14	0.254	-.0396464	.1501276	
Marital HHD	-.0123303	.0133284	-0.93	0.355	-.0384576	.013797	
Sex HHD							
1. Male	-.0098026	.0474171	-0.21	0.836	-.1027531	.0831478	
Age HHD	-.0003791	.0006763	-0.56	0.575	-.0017049	.0009467	
Household size	.0006405	.002344	0.27	0.785	-.0039544	.0052354	
Farm size	.0060581	.0020611	2.94	0.003	.0020178	.0100984	***
FISP	-.0041244	.0098735	-0.42	0.676	-.0234791	.0152303	
Off-farm income	.0208563	.0133424	1.56	0.118	-.0052984	.047011	
Distance to an agricultural market	-.0001547	.0001446	-1.07	0.285	-.0004382	.0001288	
Residence							
1. Rural	.0644199	.0189424	3.40	0.001	.0272876	.1015521	***
Interaction Terms							
Sex of HHD × Age of HHD	.0004869	.0007601	0.64	0.522	-.001003	.0019768	
Sex of HHD × Education level of HHD	-.0132653	.0170714	-0.78	0.437	-.0467298	.0201992	
Off-farm Income × Farm size	-.0067419	.0040247	-1.68	0.094	-.0146313	.0011475	*
_cons	-.031685	.0482247	-0.66	0.511	-.1262187	.0628486	
					Number of obs	7698	

Source: *Author, computed from RALS 2015 survey data*

Table 8 indicates that a household with a loan society membership had significantly higher credit access than otherwise, with a difference of 0.052, at a p-value = 0.004. Whereas a family whose head was related to the Headman/ Headwoman had significantly higher credit access as compared to otherwise, with a difference of 0.079 and a p-value =0.000. Table 9 below, showing estimation tests justifies the validity of the instrumental variables used in the study.

table 9 estimation tests

F test of excluded instruments:	
F(2, 7679) =	30.58
Prob > F =	0.0000
Sanderson-Windmeijer multivariate F test of excluded instruments:	
F(2, 7679) =	30.58
Prob > F =	0.0000
Weak identification test	
Ho: equation is weakly identified	
Cragg-Donald Wald F statistic	30.58
Stock-Yogo weak ID test critical values for K1=1 and L1=2:	
10% maximal IV size	19.93
15% maximal IV size	11.59
20% maximal IV size	8.75
25% maximal IV size	7.25
Source: Stock-Yogo (2005). Reproduced by permission.	
Weak-instrument-robust inference	
Tests of joint significance of endogenous regressors B1 in main equation	
Ho: B1=0 and orthogonality conditions are valid	
Anderson-Rubin Wald test F(2,7679)= 3.78	P-val=0.0229
Anderson-Rubin Wald test Chi-sq(2)= 7.57	P-val=0.0227
Stock-Wright LM S statistic Chi-sq(2)= 7.57	P-val=0.0227
Number of observations N =	7698
Number of regressors K =	18
Number of endogenous regressors K1 =	1
Number of instruments L =	19
Number of excluded instruments L1 =	2
Sargan statistic (overidentification test of all instruments):	2.527
Chi-sq(1) P-val =	0.1119

Source: *Author, computed from RALS 2015 survey data*

table 10 second-stage IV regression of HDDS

HDDS	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Credit access	.3521754	.1718846	2.05	0.040	.0152878	.6890629	**
Agricultural advice	-.0305871	.0300646	-1.02	0.309	-.0895127	.0283384	
Education Level of HHD							
1. Primary	-.0337911	.028286	-1.19	0.232	-.0892307	.0216485	
2. Secondary	-.119263	.0482072	-2.47	0.013	-.2137474	-.0247786	**
3. Tertiary	-.2207785	.0774343	-2.85	0.004	-.372547	-.0690101	***
Marital status of HHD	-.0201785	.021276	-0.95	0.343	-.0618787	.0215216	
Sex of HHD							
1. Male	-.2248117	.0753251	-2.98	0.003	-.3724461	-.0771772	***
Age of HHD	-.0041185	.001076	-3.83	0.000	-.0062273	-.0020097	***
Household size	.0014253	.0037235	0.38	0.702	-.0058726	.0087231	
Farm Size	-.0086185	.0034381	-2.51	0.012	-.0153571	-.00188	**
FISP	.0000783	.0157201	0.00	0.996	-.0307326	.0308891	
Off-farm income	-.0084668	.0215085	-0.39	0.694	-.0506227	.0336891	
Distance to an agricultural market	-.00017	.0002308	-0.74	0.461	-.0006223	.0002823	
Residence							
1. Rural	.0686548	.0334456	2.05	0.040	.0031026	.1342071	**
Interaction Term							
Sex of HHD × Age of HHD	.004103	.0012095	3.39	0.001	.0017323	.0064737	***
Sex of HHD × Education level of HDDS	.059204	.0272227	2.17	0.030	.0058486	.1125595	**
Off-farm Income × Farm size	.0176051	.0065272	2.70	0.007	.0048121	.0303981	***
Constant	.982175	.0766082	12.82	0.000	.8320257	1.132324	***
Number of obs	7698.000			F (17, 7680)		3.25	
Prob > F	0.000			Uncentered R2 =		0.6489	
				Centered R2 =		-0.0324	

**** p<0.01, ** p<0.05, * p<0.1 (**Source:** Author, computed from RALS 2015 survey data)*

The estimation tests in table 9 show a Joint F-statistic = 30.58, which is higher than 10 (F>10). The Cragg-Donald F-statistic = 30.58, rejecting the null hypothesis of the weak instrument. The Anderson-Rubin Wald test and Stock-Wright LM statistic are significant; thus, rejecting the null hypothesis and indicating that the endogenous regressors are relevant. Whereas the Sargan statistic with a p-value = 0.1119 fails to reject the null hypothesis concluding that the over-identification restrictions are valid, justifying the use of the two instrumental variables and the instruments are exogenous. Whereas table 10 highlights the regression results explained below.

The results in table 10 indicate that households that accessed credit consumed a significantly higher dietary diversity than otherwise, with a difference of 0.352 units at a p-value=0.040. Households with heads that have spent more years in formal education up to secondary and tertiary levels consumed at a lower dietary diversity level than the households whose heads have no years spent in formal education with a significant difference of 0.119 units and 0.221units respectively. A p-value=0.013 for secondary education and p-value=0.004 for a household head who has attained up to the tertiary level of education. Furthermore, Households headed by a male consume at a lower dietary diversity than their female-headed household counterparts with a significant difference of 0.225, at a p-value = 0.003.

At the same time, a unit increase in the household head's age has a significant negative effect on the household dietary diversity by 0.4% with a p-value of 0.000. Also, a unit increase in the Farm size of the household has a significantly negative effect on household dietary diversity by 0.9% with a p-value = 0.012.

Also, households living in rural areas consume a higher level of dietary diversity than their urban counterparts, with a significant difference of 0.069units. At a p-value of 0.040. Furthermore, a household headed by a male head depending on the age of the household head consumes a higher level of dietary diversity than their female-headed household counterparts with a significant difference of 0.004 units. At a p-value=0.001.

Also, male-headed household's depending on the years the head has spent in formal education consumes a higher dietary diversity than otherwise, with a significant difference of 0.059 units at a p-value=0.030. Finally, households earning an off-farm income depending on the size of

the household's Farm consumed higher dietary diversity than otherwise, with a significant difference of 0.018 units at a p-value=0.007. The next section discusses these findings.

4.3Discussion of results

The study assessed the association between smallholder access to credit and dietary diversity. And the effects of social demographic and economic factors of dietary diversity in Zambia.

4.3.1 Impact of access to credit and dietary diversity

In the study, access to credit was an effective intervention solution for dietary diversity among smallholder farmers because it enhances the household's liquidity. If it's cash credit, a family can use some of that credit to purchase the variety of food groups for consumption. Alternatively, if credit access is in the form of inputs, the household can produce crops in bulk for sale, then use part of the income generated to purchase the variety of food groups for consumption. Though, seeing that most households that accessed credit might have also located FISP. These results cannot be generalized, and they are restricted only to this type of a smallholder population, which is likely to receive FISP, which is a limitation. The results are consistent with the finding (Jalil, 2015; Annim and Frempong, 2018), which suggests that access to credit significantly improves the household's dietary diversity. Contradicting the findings (Diagne and Zeller, 2001; Diagne, 1998) indicates no significant effect between credit access and household dietary diversity. The studies also attribute these results to low credit participation among smallholder households and the lack of transport and irrigation technology to help smallholder farmers fully realize the ensued benefits of credit access, especially during droughts.

4.3.2 Other factors that impact dietary diversity.

Furthermore, the study established that a household whose head has spent more years in formal education up to secondary and tertiary levels consumed a lower dietary diversity level than the households whose head has no years spent in formal education. Mostly due to the levels of participation at a secondary and tertiary level by most households. With only 26.01% and 3.85% of female and male heads completing secondary and tertiary education. However, most heads had

completed primary school (Female, 60%, n=983; Male, 56.64%, n=3439), which was insignificant towards enhancing a household's dietary diversity. Whereas some heads had completed secondary education (Female, 12.79%, n=208; Male, 29.55%, n=1794), and others had reached tertiary education (Female, 2.09%, n=34; Male, 4.31%, n=262). About 24.66% and 9.50% female and male household heads had no education at all, respectively. Most of the household heads used for this study had a low level of education at a secondary and tertiary level. It affected the household's choice of foods consumed as most households could not make proper decisions on household nutrition by selecting a diverse range of food groups for consumption. However, the high education attainment by a male household head in formal education allowed male-headed households to consume higher dietary diversity than their female counterparts. Mostly due to the low education participation by female household heads. The results are in line with the findings (Emmanuel et al., 2019), who established that low education attainment by a household head in Zambia hampered the household's ability to select a diverse range of food groups for consumption. The results are consistent with the finding of (Jalil, 2015; Justus, Victor, Phillipo, and Thomas, 2017; Simonette et al., 2014; Robert et al., 2019; Habtamu et al., 2018; Negash, 2015) which establish that household's with a more educated head were more likely to be rich in dietary diversity.

Also, the study showed that male-controlled decisions on food consumption are not nutritious-cautious compared to their female counterparts who often make decisions centred at enhancing the well-being of the family members, especially children. However, depending on the age and education level attained. A male head would have saved up enough income over time to contribute positively to the household's overall dietary diversity. Also, the years spent in formal education equips the household head to make better-informed decisions regarding dietary diversity. These results are consistent with the finding (Jalil, 2015), which established that female-headed households are rich in HDDS compared to male-headed families, which contradicts the results in studies by (Habtamu, 2018; Negash, 2015; Justus, Victor, Phillipo, and Thomas, 2017).

Besides, an increase in the age of the household head reduces the household's dietary diversity. However, an increase in the age of a male household head can cause the family to consume more diversified foods. Mostly because male household heads overtime would have

saved up enough income from working in the public and private sector to contribute financially to the dietary diversity and nutrition of the household as compared to their female counterparts. As earlier indicated, female household heads are often more nutrition cautious, especially regarding the well-being of the family members, and with age, their nutrition controlled decisions don't change. These results are in line with the findings (Habtamu et al., 2018), which indicate a negative relationship between the age of the household head and the household dietary diversity. Still, the interaction between the household head's age and sex can be compared to the findings (Wasiu and Burhan, 2017), which established a significant positive effect between the age of the household head and dietary diversity. Though (Wasiu and Burhan, 2017) did not put into consideration the sex specifics of age. The study contradicts the findings (Ngema et al., 2018), which established no association between the age of the household head and dietary diversity.

Furthermore, smallholder farmers in Zambia mostly cultivate only a small part of their land. And as a result, they can only grow very few, if not one crop on that piece of land, which reduces their overall household's dietary diversity, however, with an increase in household off-farm income. The smallholder household can buy enough farm inputs to expand production and produce various food groups in different portions of the farmland, which enables the family to consume at a higher dietary diversity. These results are consistent with the findings (Jalil, 2015; and Justus, Victor, Phillipo, and Thomas, 2017), indicating a significant positive effect between farm size and dietary diversity and citing that the large farm size allows households to produce more food improving their dietary diversity. The results are against the findings (Habtamu et al., 2018; Ngema et al., 2018), indicating no association between farm size and household dietary diversity.

Finally, though, urban areas are developed with more food outlets. The study has shown that smallholder farmers living in the rural part of the country are consuming more diversified diets than those living in urban areas. The study attributes the results to the fact that most smallholder farmers interviewed were located closer to an established market. And the food in rural areas is cheaper than in urban areas. In line with the conclusions made by Mukherjee et al. (2018), dietary diversity is high in rural areas compared to urban areas. Though studies by (Kalle 2016; Cock et al., 2013) argued against, establishing that households in urban areas of the province tend to have a higher dietary diversity because they tend to be more educated.

CHAPTER FIVE

CONCLUSION, RECOMMENDATIONS, AND AREAS OF FURTHER RESEARCH.

4 Introduction

The previous chapter discussed the descriptive statistics and empirical findings on the effects of smallholder access to credit on dietary diversity in Zambia. However, the chapter gives the conclusion, recommendations, and areas of further research for this study in Zambia regarding the findings.

4.1 Conclusion and recommendations

The study has shown that smallholder credit participation in Zambia is meager, but credit access can improve a smallholder household's dietary diversity. However, these results cannot be generalised to the whole smallholder population, only to that population of smallholder farmers, which is likely to receive FISP. At the same time, education attainment by smallholder households at a secondary and tertiary level by the sampled population restricted the household's selection of a variety of food groups for consumption. As seen in the household's preference for maize-based foods such as porridge and nshima than mixed foods, the results are consistent with the findings (Emmanuel et al., 2019), indicating that lack of education reduced dietary diversity in Zambia. These relationships, if unaddressed, can hurt the household's nutrition. Primarily that food choice is restricted to household food security.

At the same time, male household heads depending on their age, can contribute financially to the household's dietary diversity. Smallholder households usually cultivate a small portion of the far producing one or two food groups, which can negatively affect the household's dietary diversity, but if the family can earn an off-farm income. They can expand production on the farm, producing more food groups that can improve their dietary diversity. Finally, the study also established that smallholder households living in rural areas consumed a higher level of dietary

diversity than their urban counterparts. Ultimately, the study has provided valuable information on smallholder household credit access and education attainment in Zambia. Thus, it makes the following recommendations:

1. The government should aim to promote financial inclusion in agricultural credit of smallholder farmers by encouraging the operations of credit institutions through tax exemptions and financial support systems to ensure smallholder credit participation at a reduced cost

2. The government should aim to strengthen education participation among smallholder households, by promoting the operations of organizations that aim to encourage smallholder farmers to pursue more years in formal education.

4.2 Areas of further research

The study, just like many other studies, is context-specific. And as such is only a piece of the growing body of knowledge. In this case, the piece is on farmer access to credit and dietary diversity in Zambia. The study has left a question that will require further clarification in time, such as the long-term effect of smallholder farmer access to credit on household dietary diversity. The results indicate that credit access has a significant positive effect on household dietary diversity in the short term. Still, it will be very insightful to have a study that measures the long term effects of credit participation on dietary diversity, considering all the time-variant events such as droughts in credit participation and how it influences household dietary diversity. Such a study can help design smallholder credit schemes and training programmes to have a long-term effect on household dietary diversity and help reduce malnutrition in Zambia.

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Appendix: Descriptive statistics on the other factors that affect dietary diversity

1. Agricultural advice

table a.1 agricultural advice received by residence

Residence	**No agricultural advice**	**Received agricultural advice**
Population of rural households that received and didn't receive agricultural advice	1295	5944
Population of rural households that received and didn't receive agricultural advice by percentage (%)	17.89	82.11
Population of urban households that received and didn't receive agricultural advice	99	360
Population of urban households that received and didn't receive agricultural advice by percentage (%)	21.57	78.43
Population of households that received and didn't receive agricultural advice.	1394	6304
Population of households that received and didn't receive agricultural advice by percentage (%)	18.11	81.89

First row has frequencies and second row has row percentages

Source: *Author, computed from RALS 2015 survey data.*

Table a.1 summarizes the frequencies and percentages of household participation in agricultural advice in rural and urban residences. The results indicate that more than 50% of smallholder farmers countrywide had received agricultural advice, with the proportion being high in rural areas with about 82.11%. In urban areas, 78.43% of smallholder farming households reported having received agricultural advice.

2. Farmer input support programme (FISP)

table a.2 fisp received by residence

Residence	**Didn't Receive FISP**	**Received FISP**
Population of rural households that received and didn't receive FISP	5232	2007
Population of rural households that received and didn't receive FISP by percentage (%)	72.28	27.72
Population of urban households that received and didn't receive FISP	333	126
Population of urban households that received and didn't receive FISP by Percentage (%)	72.55	27.45
Population of households that received and didn't receive FISP	5565	2133
Population of households that received and didn't receive FISP by Percentage (%)	72.29	27.71

First row has frequencies and second row has row percentages

Source: *Author, computed from RALS 2015 survey data.*

Table a.2 indicates the percentage of smallholder farming households who received FISP in the 2014/15 farming season. The results show that the rate of smallholder households that accessed farmer input support (FISP) was low countrywide with less than 50% of the smallholder farmers in both residences accessing the input support and from the proportion of smallholder households that received FISP about 27.72% and 27.45% of the smallholder farmers in both the rural and urban residence populations respectively accessed FISP, contributing to a national average of 27.71% of smallholder farming households participating in FISP countrywide.

3. Off- farm income

table a.3 off-farm income received by residence

Residence	**Didn't earn as off-farm income**	**Earned an off-farm income**
Population of rural households that earned an off-farm income and those that didn't earn an off-farm income	5169	2070
Population of rural households that earned an off-farm income and those that didn't earn an off-farm income by percentage (%)	71.40	28.60
Population of urban households that earned an off-farm income and those that didn't earn an off-farm income**.**	264	195
Population of urban households that earned an off-farm income and those that didn't earn an off-farm income by percentage (%)	57.52	42.48
Population of households that earned an off-farm income and those that didn't earn an off-farm income**l**	5433	2265
Population of households that earned an off-farm income and those that didn't earn an off-farm income by percentage (%)	70.58	29.42

First row has frequencies and second row has row percentages
Source: *Author, computed from RALS 2015 survey data.*

Table a.3 indicates the percentage of smallholder farmers that earned an income through off-farm activities. The results show that the majority of smallholder households in rural and urban areas spent most of their time working on-farm. Very few of the farmers worked off-farm with a national average of 29.42% of the smallholder farmers working off-farm, where 28.60% and 42.48% of the smallholder farmers in the rural and urban populations earned an off-farm income.

4. Distance to an established agricultural market

This section shows that the mean distance traveled by smallholder farmers to the nearest established agricultural market is 24.884 km. However, the distance was 5km less for 25% of the smallholder population, 14km less at the 50th percentile of the smallholder population (median). And 65km less at the 90th percentile. The results mean that the remaining 10% of the smallholder population faced a higher than 65km. As presented in table a.4 below.

table a.4 distance to an established agricultural market

Percentiles	**25th**	**50th (median)**	**90th**	**Mean**
Distance (Km)	5	14	65	24.884

Source: *Author, computed from RALS 2015 survey data.*

5. Farm size

The mean farm size cultivated by smallholder farming households is 2.288Ha. However, 25% of the smallholder population cultivate on land less than 0.875Ha while the 50th percentile of the smallholder farming population cultivate on land less than 1.62Ha, and the 90th percentile of the smallholder farming population cultivate on land less than 4.75Ha meaning that the remaining 10% of the smallholder farming household population grow crops on land more than 4.75Ha as presented below in table a.5.

table a.5 farm size

Percentiles	**25th**	**50th (median)**	**90th**	**Mean**
Farm size (Ha)	0.875	1.62	4.75	2.288

Source: *Author, computed from RALS 2015 survey data.*

6. Age of the household head

The mean age for the heads of the smallholder farming households is 49 years old. However, 25% of the household heads in the smallholder population are less than 37 years of age. In contrast, the 50th percentile of the household heads in the smallholder population is less than 46 years of age. The 90th percentile of household heads in the smallholder population is less than 70 years of age. And the remaining 10% of household heads in the smallholder farming population are above 70 years of age. The results are documented in table a.6.

table a.6 age of the household head

Percentiles	**25th**	**50th (median)**	**90th**	**Mean**
Age of HHD (years)	37	46	70	49

Source: *Author, computed from RALS 2015 survey data.*

7. Household size

The mean number of members in a smallholder household is four people. However, 25% of the smallholder households have less than two members while 50% of the smallholder household population contains less four people, the 90th percentile number of members in a household is less than seven people, and this means the remaining 10% of smallholder households contain more than seven family members as indicated in table a.7 below.

table a.7 household size

Percentiles	**25th**	**50th (median)**	**90th**	**Mean**
Household Size (numbers of people)	2	4	7	4

Source: *Author, computed from RALS 2015 survey data.*

8. Education level

The mean education level for smallholder household heads is the primary level, which is seven years of formal education. The results indicate that more than 50% of smallholder household heads have attained some primary education level in rural and urban areas. Individually, in rural regions approximately 12.76% have never attained an education, about 57.33% have attained up to primary level, 25.98% have attained up to secondary level, and 3.92% of smallholder household heads reported to have attained up to the tertiary level of education while, in the urban part of the country approximately; 11.76%, 59.26%, 26.36%, and 2.61% of the smallholder household heads reported to have attained no formal education, primary, secondary, and tertiary level education respectively as shown in table a.8 below.

table a.8 education level by residence

Residence	**Education level**			
	None	Primary	Secondary	Tertiary
Population of rural households that have attained an education and those that have attained no education.	924	4150	1881	284
Population of rural households that have attained an education and those that have attained no education by Percentage (%)	12.76	57.33	25.98	3.92
Population of urban households that have attained an education and those that have attained no education	54	272	121	12
Population of urban households that have attained an education and those that have attained no education by percentage (%)	11.76	59.26	26.36	2.61
Population of households that have attained an education and those that have attained no education	978	4422	2002	296
Population of households that have attained an education and those that have not attained any education by percentage (%)	12.70	57.44	26.01	3.85

First row has frequencies and second row has row percentages
Source: *Author, computed from RALS 2015 survey data.*

Furthermore, table a.9 indicates that education attainment amongst household heads is very low. With more than 50% of the household heads attaining up to the primary level of formal education, but after that level, very few heads pursued more years in formal education with the least being female household heads were 12.79% and 2.09% attaining formal education at a secondary and

tertiary level respectively. Whereas only 29.55% and 4.31% of male heads pursued years of formal education at a secondary and tertiary level. Showing poor education attainment at a secondary and tertiary level of formal education.

table a.9 education level by sex

Sex of the household head	Education attainment			
	None	Primary	Secondary	Tertiary
Population of females that have attained an education and those that have attained no education	401	983	208	34
Population of females that have attained an education and those that have attained no education by Percentage (%)	24.66	60.46	12.79	2.09
Population of males that have attained an education and those that have attained no education	577	3439	1794	262
Population of male that have attained an education and those that have attained no education by percentage (%)	9.50	56.64	29.55	4.31
Population of households that have attained an education and those that have attained no education	978	4422	2002	296

First row has frequencies and second row has row percentages
Source: *Author, computed from RALS 2015 survey data.*

9. Marital status

On average, over 50% of smallholder household heads countrywide reported being in a monogamous marriage. Notably, in the urban residence, 1.09% of smallholder household heads said they have never been married, whereas 0.22% are cohabiting, 59.91% are monogamously married, and 8.71% are polygamously married, 1.96% are in separation, 13.73% are divorced, and 14.38% are widowed. As compared to the rural residence of the country where; 1.15% of the smallholder household heads reported have never been married, 0.08% are cohabiting, 61.03% are

in a monogamous marriage, 10.89% are in a polygamous marriage, 1.19% are separated, 13.26% divorced, and 12.41% are widows as indicated by table a.10 below.

table a.10 marital status by residence

Residence	Never married	Cohabit	Monogamously married	Polygamously married	Separated	Divorced	Widowed
Population of households in the rural that are married and those never married	83	6	4418	788	86	960	898
Population of households in the rural that are married and those never married by percentage (%)	1.15	0.08	61.03	10.89	1.19	13.26	12.41
Population of urban households that are married and those never married	5	1	275	40	9	63	66
Population of urban households that are married and those never married by percentage (%)	1.09	0.22	59.91	8.71	1.96	13.73	14.38
Population of households that are married and those never married	88	7	4693	828	95	1023	964
Population of households that are married and those never married (%)	1.14	0.09	60.96	10.76	1.23	13.29	12.52

First row has frequencies and second row has row percentages
Source: *Author, computed from RALS 2015 survey data.*

10. Sex of the household head

In terms of the gender of the household head, table 10 shows the majority of smallholder farming households in the rural part of Zambia are headed by men with a national average of 78.88%. Specifically, the percentage of male-headed households is highest in the rural parts of the country at 78.89%, whilst women head 21.11% of smallholder households. Whereas men head the urban residence, 78.65% of smallholder households, only 21.35% of the smallholder households reported having been headed by women as indicated in table a.11 below..

table a.11 sex of household head by residence

Residence	**Female**	**Male**
Population of **rural** households that are either male or female	1528	5711
Population of rural households that are either male or female by percentage (%)	21.11	78.89
Population of **urban** households that are either male or female	98	361
Population of rural households that are either male or female by percentage (%)	21.35	78.65
Population of households that are either male or female	1626	6072
Population of households that are either male or female by percentage (%)	21.12	78.88

First row has frequencies and second row has row percentages
Source: *Author, computed from RALS 2015 survey data.*

11. Residence

Figure A.1 indicates the distribution of smallholder households interviewed during data collection in rural and urban residences. The results suggest that the percentage of smallholder households interviewed was high in the rural at 94.04% compared to the urban area, with 6.0% of smallholder households interviewed. Implying that the proportion of smallholder farmers is higher in rural areas as compared to urban areas.

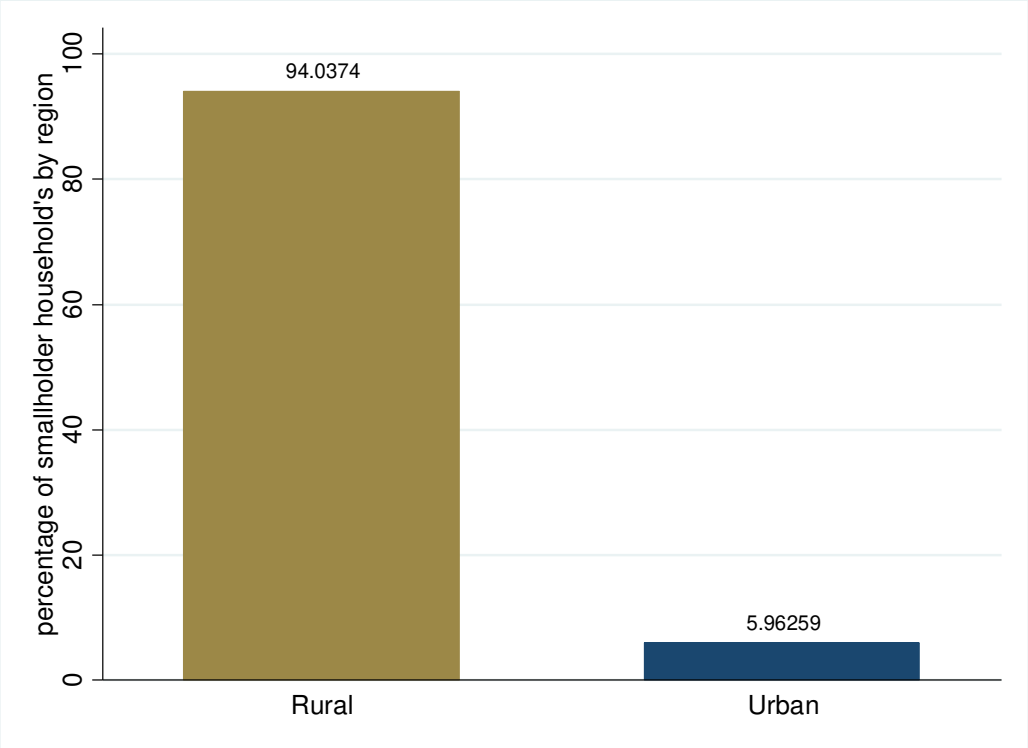

figure a.1 households by residence

Source: *Author, computed from RALS 2015 survey data.*