Exploring the Impact of Income Diversification and Safety Nets on Household Resilience to Climate Change in Malawi

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Abstract

Malawi is increasingly plagued by extreme weather events such as prolonged droughts, floods, and irregular rains. As the effects of worsening climate change intensify, the country's most vulnerable households which rely on subsistence farming will be severely impacted. The effect that income diversification can have on the Malawi economy is crucial to understand since the economy is so deeply dependent on agricultural production. Thus, the aim of this study is to analyze the differences between rural Malawian farming households at varying levels of the wealth distribution and determine how these households are impacted by diversification strategies and climatic weather shocks. Using quantitative methods, this paper utilizes 2013 LSMS Integrated Household Panel Survey data, combined with disaster data from the EM-DAT International Disaster Database to study household consumption levels impacted by extended droughts or floods. The results of this study indicate that when linked with safety nets and distance to nearest agricultural markets, outcomes of diversification and consumption are significantly higher. These findings suggest that improved access to social safety nets can help households further adopt diversification strategies and reduce poverty rates.

Keywords: Malawi, diversification, rural, climate change, disasters, weather shocks, safety nets, social protection, poverty, crop diversification

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List of Abbreviations

EM-DAT	International Disaster Emergency Database
FAO	Food and Agriculture Organization
FISP	Food Insecurity Response Plan
IHS3	Third Integrated Household Survey
ILO	International Labor Organization
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
SSA	sub-Saharan Africa
WMS	World Monitoring Survey

Introduction

Malawi is a landlocked country in sub-Saharan Africa (SSA) with a population of nearly 18 million, and an annual GDP per capita of US$486 as of 2017 (Economics 2018). Population growth is nearly 2.9% annually and is expected to continue to rise with birth rates at approximately 4.57 per woman, which is twice the global average (ILO n.d.) The population in Malawi is also characterized by a large youth population (48%), low life expectancy, and a high age dependency ratio (88.57%). Reports now estimate that population totals could grow to reach 26 million by 2030. The upsurge in population growth since 1966 has severely impacted poverty levels in a country already struggling economically. Malawi is listed as having one of the highest poverty rates in SSA at 50.7% as of 2017 (IMF 2017). Further, the Welfare Monitoring Survey (WMS) conducted a study in 2010 which classified Malawi as having one of the world's least diversified economies with an estimated 84% of the employed population working in agriculture; 7% in wholesale and retail; and just 1% in manufacturing and construction (Asfaw 2015). Nearly 85% of Malawians live in rural areas of the country and depend solely on subsistence farming for income and food security. The countries high incidence of poverty, coupled with its flourishing demographic profile creates a pressing need for Malawians to break their dependence on agricultural farming as an income source and find new ways to diversify the economy.

Within Malawi, smallholder farmers depend heavily on agriculture and the production of maize, the country's staple crop, as a food and income source. However, according to the World Bank, Malawi is ranked one of the world's twelve most vulnerable countries to the adverse effects of climate change (World Bank 2010). Therefore, the dependence of Malawi's working population on maize crops for subsistence farming will increasingly expose these households to the economic stressors stemming from climate change and have resounding effects on the country's economic progress. Although Malawi has a long history of climate events such as droughts, floods, and erratic rains, the frequency and intensity of these weather conditions has increased as the warming trend associated with climate change continues. Temperature increases, changes in precipitation patterns, extended dry periods, and erratic rainfall all point to the worsening effects of climate change (USAID 2016). The continuous threat and

impact of climate change has already had a severe impact on the food supply and agriculture-based economy of Malawi. Agricultural productivity is low, with yield estimates at 1.5 tons per hectare each year (Sesmero 2018). The countries high population growth, widespread occurrence of soil erosion, and ongoing deforestation within Malawi have made it ever more vulnerable to the adverse consequences of climate change (Sesmero 2018). High population growth and population density have also led to shrinking farm sizes, a decline in the availability of fallow land for crops, and the continuous planting of maize crops, which have resulted in mass depletion of soil fertility (Sesmero 2018).

Due to the high incidence of poverty, dependence on agricultural activities, and the increased exposure to worsening climate events, the country continues to be vulnerable to repeated shocks. In response to these ongoing development issues, the Government of Malawi has instituted various agricultural programs and social safety net interventions to address the drivers of domestic climate change and improve livelihood opportunities for vulnerable households. Although these programs have been expanded over the years, their coverage rates remain low. As such, in vast parts of the country, large groups of Malawians have been left without the protection of social safety net support. In turn, the challenges of food supply shortages and economic downturns have prompted smallholder farmers across Malawi to engage in crop, labor, and income diversification. Diversification strategies often differ by household income and are heavily influenced by the socio-economic factors which drive poverty across the country. These activities are a direct response to the growing needs of households created by increased exposure to the risks of weather-related shocks. Subsequently, increasingly frequent droughts and floods will have significant impacts on smallholder farmer's choices over adaptation strategies in response to changing climate.

Therefore, the aim of this study is to investigate whether or not diversification strategies differ for households across the wealth distribution in Malawi and further understand how these strategies are correlated with climate variability impacts. This study seeks to understand whether or not a lack of diversified income sources has led to increased poverty rates in Malawi and, to what degree income or crop diversification can act as effective climate change adaptation strategies for households. These aims are achieved by evaluating 2013 LSMS household survey panel data from the World Bank in order to

identify relevant factors which influenced wellbeing measures for households at varying income levels. Through an analysis of this data, the study found a significant relationship between diversification and lower rates of poverty. In addition, using both distance to agricultural markets and social safety nets as instruments for diversification, the study found that these factors also play an important role in whether or not a household is able to improve diversification outcomes. By evaluating diversification methods, this study hopes to provide policymakers with information on how to both identify those methods which have proved most successful in alleviating poverty as well as provide potential policy suggestions on how to promote improved diversification strategies for poor or low-income households. The results of this study have significant policy implications and can provide valuable insights in to the importance of reallocating resources in order to improve social support mechanisms.

This paper proceeds as follows. In chapter 1, an analysis of recent literature and studies is presented on climate variability, diversification strategies, food security issues, and the theoretical framework for this study. Chapter 2 will provide an overview of the data and methodology employed, along with descriptive statistics and index development. Chapter 3 reviews the study results and discusses the implications of the findings. Finally, chapter 4 concludes this paper with main findings and potential policy measures.

Chapter 1 – Literature Review

The agriculture sector in Malawi is comprised of both estate farms and smallholder farmers, the latter of which accounts for approximately 90% of total farms and generates around 75% of total agricultural output. The staple crops grown are maize, cotton, groundnut wheat, rice, coffee, and tobacco, with 93% of farmers growing maize varieties. While maize is the dominant food crop and is critical to maintaining food security for Malawians, it is also extremely vulnerable to varying weather during the growing process (Mango 2018). Particularly, rural households which depend significantly on maize crops, have been found to be heavily influenced by climate change factors and pushed to adapt to increasing threats presented by weather shocks. Therefore, in the Malawi economy, which is heavily dependent on agriculture, climate variability is thus inextricably linked to farm-income variability (Asfaw 2015). The literature on household poverty levels and climate change impacts across Malawi indicates that climate variability is one of the main drivers of diversification for communities in developing countries. Increasingly, those households which rely on subsistence farming to support their food stores and livelihoods will face challenges related to the disruption of agricultural production due to climate change. As a result, diversification often becomes a necessary measure to help households cope and mitigate risks stemming from climate shocks.

1.1 Climate variability

Smallholder farmers engaged in agricultural production face increasingly frequent severe weather threats in the form of floods, droughts, irregular rains, and extreme heat episodes. All of these climate events act as exogenous shocks which contribute significantly to the economic issues affecting smallholder agriculture in Malawi. Over the last fifty to hundred years, temperatures across SSA have increased by 0.5° Celsius, and are expected to continue to rise by 4° Celsius by the end of the 21st century (Niang 2014). Parts of SSA are also expected to receive decreasing amounts of precipitation and increased rainfall variability as climate change worsens. During the rainy season, rainfall averages typically range from 725 mm to 2,500 mm, however, droughts have also become much more common

across Malawi. The International Disaster Database (EM-DAT) reports that major droughts occurred in Malawi in 2002, 2005, 2007, 2012, and 2015 (EM-DAT 2019). Frequent flooding is also a major issue which severely affects the low-lying areas of the Lower Shire River floodplain and surrounding communities along Lake Malawi. Devastating flood events occurred in Malawi in 2001, 2002, 2003, 2005, 2006, 2007, 2008, 2011, 2012, and 2015-2019 (EM-DAT 2019). As temperatures continue to rise in response to climate change factors, these areas will also increasingly experience risks associated with extreme heat.

Asfaw et al found that weather patterns vary by region in Malawi. Areas in the Northern region have more favorable rainfall conditions, but still experience high variability. Across the Southern areas, farmers are much more vulnerable to lower average rainfall combined with the highest rainfall variability. In the Central region, the average rainfall estimates are higher than in the South but lower than in the North, coupled with the lowest variability in rainfall (Asfaw 2015). In particular, disaster prone districts in the Southern regions are most susceptible to increased risk of crop failure and low harvests. Poorer households within these districts tend to rely much more on the production of maize from season to season. Studies have also found that, for these households, the continued production of maize in combination with weather shocks often leads to a climate induced "maize poverty trap", where smallholder farmers continue to grow this staple food crop regardless of land suitability in an effort to supplement food stores (Sesmero 2018). Changes in climate, which are linked to farm-income variability are key drivers of diversification for developing countries.

1.2 Diversification strategies by income level

Households across rural areas of Malawi choose various diversification strategies in an effort to cope with risks and threats to agricultural activities. Many of the diversification measures utilized act as adaptation mechanisms in response to constraints which are more frequently imposed upon them by the increasing risk of climate variability and exogenous shocks (Asfaw 2015, 2). Across the income and wealth distribution spectrum within Malawi, wealthy and poor households must contend with shocks using diversification strategies which adequately address their ability to access available financial and

insurance mechanisms. The most frequent adaptation strategies include; diversifying of income between on-farm and off-farm activities, crop diversification, and adjusting the quantity of inputs which are applied in the production process (Sesmero 2018). Poorer households tend to face higher vulnerability, with a higher risk level, coupled with very low asset holdings, a high number of dependents, very limited to no education, and often live in isolated communities with little infrastructure and access to basic services. In comparison, wealthier or non-poor households, can experience vulnerability, also have high risk, but this is often linked with a modest asset base, some access to informal or formal insurance, in potentially isolated areas with greater access to opportunities to diversify income sources (McCarthy 2016). As such, households at varying income levels are pushed or pulled in to diversification based on different factors which are related to the strategies available to them.

Research indicates that households at various income levels are motivated by different push and pull factors which help determine the levels and types of diversification. The diversification methods used depend heavily on whether or not a farming household has any endowments or there are off-farm opportunities available to engage in (Asfaw 2015). Poorer households are most often pushed in to diversification due to a lack of alternatives for coping with risk. According to Lipper et al, significant push factors which drive poor households to diversify include: managing risk and income variability, adapting to heterogenous agro-ecological production conditions, and the need to adapt to changing weather conditions (Lipper 2010). These households, in response to climate variability, often rely on crop diversification and off farm work such as *ganyu* labor. Crop diversification varies depending on the resource endowments available to households. Poor farming households with fewer resources often use crop diversification as an essential part of their strategy for managing production and risks associated with price volatility (FAO, 2017). However, very poor households have less opportunity for diversification due to the many burdens these households contend with, such as access to markets.

In contrast, wealthier households are motivated by pull factors such as higher wages, higher returns for entrepreneurial activities, greater economic efficiency, and the potential for higher aggregate output. These households have greater financing availability, and higher education levels, in addition

to improved access to markets and infrastructure (Asfaw 2015). The availability of these resources allows wealthier households to employ diversification as a wealth generator which provides higher returns for specialization, whereas, poor households turn to diversification to maintain welfare. A 2006 study by Peters, found that better-off households were, on average, more likely to have more land, the ability to produce larger maize harvests and a more diverse crop, were more likely to grow tobacco, and had higher levels of income from off-farm and farm sources (Peters 2006). The strategies used by wealthier households most often include labor and income diversification which assists these households in transitioning from subsistence farming to more commercial agriculture (Pingali 1995). The availability of financing also provides higher inputs which wealthier households can use to invest in improved seed varieties or hybrid seeds.

1.3 Crop diversification

In Malawi, the main crops grown across the country are maize, cotton, tobacco, groundnut wheat, rice, coffee, and sugarcane. However, the dominant crop is maize with approximately 93-99% of smallholder farmers across the country engaged in farming this crop, and 70% of arable land allocated to maize production (Asfaw 2015). In addition, maize accounts for nearly 60% of per capita caloric intake (Sesmero 2018). Unfortunately, maize crops are more susceptible to the temperate changes in climate and water availability. As a diversification measure, crop diversification is the addition of new crops or a cropping system within agricultural production on a farm (FAO, 2017). The highest levels of crop diversification are found in the southern region of the country where the highest risk of drought exists. While crop diversification can have significant benefits for poor households, this type of diversification may benefit wealthier households less. Evidence from Burkina Faso, Malawi, and Zambia, suggests that as household income levels increase, the potential economic benefits of crop diversification begin to decline (FAO, 2017). This likely points to the varied input and output market development needed at different income levels which have an impact on aggregate productivity and income.

In most cases, crop diversification is more ecologically feasible and more cost effective for lower income farming households. It allows smallholder farmers to reduce some of the uncertainties in agricultural production and brings about higher and spatial temporal biodiversity on the farm and increases resilience, so that the ecosystem on a farm can return to its original productive state after being disturbed (Njeru 2013). Farmers must make decisions regarding how to allocate land between local seed varieties, and improved varieties that are either open-pollinated varieties (OPVs) or hybrids (Sesmero 2018). Smallholder farms most often use local seed varieties based on the taste, ease of pounding, and improved storability. While the local seeds are low in yield, farmers are able to replant them in multiple seasons. However, the low production yield presents a significant problem, as approximately 75% of the food consumed in the country is produced by small-scale farmers (Mango 2018). Many smallholder farmers adopt improved seed varieties which provide higher yields, an earlier maturation rate, and higher drought resistance. Hybrid varieties are another crop diversification option which offer the highest yields but lose substantial productivity if the seeds are used in more than one planting season. Studies also show that farmers with higher levels of crop diversification are better off than their counterparts since diversification is positively correlated with food consumption (Mango 2018).

1.4 Diversification away from maize crops

Diversification strategies aimed at improving household and individual livelihoods most often include crop, labor, and income diversification. These strategies are utilized as deliberate methods for smoothing incomes and alleviating risks. Diversification can act as a type of personal safety net for the rural poor, while conversely, it may serve as a means of asset accumulation for rural rich households (Ellis 1998). Those households with higher financial means and access to formal or informal insurance mechanisms have also been found to produce tobacco crops which are more drought resistant and only lose 7% of productivity during harvest (RMSI 2009). Further, households with larger land holdings can engage in raising livestock, although this is limited in Malawi due to acute land constraints. Households on the lower end of the wealth spectrum have the least means to effectively mitigate risk

and often the most economically feasible means of diversification available is crop diversification, particularly varied maize crop production. For those wealthier households, the capacity to diversify is much higher and thus these households may choose to start non-agricultural businesses.

For those lower income households and individuals, most seek off-farm work to supplement their income. Working as an agricultural laborer on other farms is known as ganyu in Malawi. Jayne et al estimates that up to 10% of rural household income is made up of this kind of work (Janye 2010). Ganyu is used to provide extra income which can be used as inputs at planting, additional money for food purchases, or in exchange for in-kind payment in the form of maize to make up for shortages in on-farm production (Sesmero 2018). Farming households can also make determinations on the allocation of time for farming activities and how labor needs should be adjusted based on productivity levels. Finally, Downing et al. (1997) suggests that households might make "incremental adjustments in inputs" as a potential strategy for coping with climate variability in SSA (Sesmero 2018). Thus, by shifting the inputs utilized in the production process, households can reduce the risk of facing challenges related to changing climates.

1.5 Food security

Since agriculture is the primary source of income and food production in Malawi, the production of maize as a main crop is vital to maintaining food security for this population. The Food and Agriculture Organization (FAO) describes food security as a state in which all people at all times have both physical and economic access to sufficient, safe, and nutritious food which meets their dietary needs in order to fulfill an active and healthy lifestyle (FAO, 1996). By contrast, a household can become food insecure when there is either uncertainty or limited access to food. Many of the smallholder farmers in Malawi depend on crop yields for food which makes fluctuating or poor yields a potentially devastating occurrence for households reliant on this as means to satisfy basic needs. In order to ensure food security, a household must have access to adequate food supplies at all times (Mango 2018). While at the national level, there are surpluses of food crop production, there still exist

many pockets of farming households which experience food insecurity within disaster prone districts such as Salima, Chikhwawa, Nsanje, Karonga, Balaka and many others.

The worsening effects of climate change and weather variability have invariably led to increased crop failures, food shortages, malnutrition, and hunger in many parts of the country, especially in the Lower Shire part of southern Malawi (Phiri Innocent Pangapanga 2012). Households which experience shocks are at risk of losing access to primary food sources in addition to experiencing economic hardships from lost returns. In order to measure food security, a study by Mango et al (2018), employed the food consumption scores (FCS) approach to estimate a composite score made up of dietary diversity, food frequency, and nutritional importance of nine food groups. In addition, the researchers applied a household food insecurity access score (HFIAS) as a continuous measure of the degree of food insecurity to assess a household's access to food within a 30-day period. The results showed that while the majority of households were food secure at 53.1%, 25.1% had borderline consumption, and 21.8% had poor consumption. In regards to the HFIAS, the data indicates that while 22.9% of households were food secure, 70.5% had mild to moderate food insecurity, and nearly 6.6% were severely food insecure (Mango 2018). When coupled with diversification, the researchers found that the proportions of crop diversification were higher among households that were borderline food secure than those that were food insecure.

Crop diversification, as a risk management and diversification strategy, can play a critical role in helping farmers stabilize yields and secure food stores for household consumption and income. Smallholder farms that choose to invest in crop diversification, can potentially shield themselves against crop failures caused by variable weather and climate change events. A previous study by Smithson and Lenne analyzed smallholder farms which had varying crop mixtures of primarily legumes and grains and found that yields were significantly higher than those farms with less diverse crops (Smithson JB 1996). Similarly, other studies have also found that by investing in diverse crops, farmers were able to promote yield stability and create own-farm insurance since the farm would then be able to depend on the alternative crops if a particular crop failed (Mango 2018). These results highlight the importance of

smallholder farmers developing diversification strategies that help make farming processes more resilient and in turn promote food security.

1.6 Theoretical framework

Understanding the link between poverty and diversification methods affecting rural areas of Malawi, requires an examination of the pervasive features of poverty within developing countries which are vulnerability and exposure to risk. Lower income households often opt for diversification strategies which will help reduce risk but these options, although they are more stable, typically provide the lowest returns. When households consistently choose strategic options with lower returns, they can become trapped in a so called "climate-induced" poverty trap which locks poor smallholder farmers in to low-value maize production from growing season to growing season (Sesmero 2018). This cycle in itself creates an increased vulnerability to future climate shocks and economic downturns. The IPCC defines vulnerability as the extent to which a natural or social system is susceptible to sustaining damage from climate change impacts (FAO, 2016a). This concept can be understood as the capacity or ability to manage potential damages. Vulnerability differs from risk in that, risk underscores the probability of particularly damaging events occuring that can impact welfare at the household or individual level (McCarthy 2016). Further, according to McCarthy, vulnerability typically acts as a function of exposure, sensitivity, and adaptive capacity.

As exposure to risk changes over time, the impact of weather shocks compromises crop production which in turn interacts with increasing scarcity and degradation of essential environmental resources. The impending consequences of household exposure to climate events depends on the sensitivity level to this growing scarcity (FAO, 2016a). Studies have also found that households are more likely to experience poverty if there are permanent disadvantages present or a lack of endowments. In addition, McCarthy et al. notes that the capacity of a household to manage risk will determine the level of vulnerability and the likelihood of falling in to poverty (McCarthy 2016). A households adaptive capacity to employ diversification strategies will then be determined by entry points and

barriers to adoption such as lack of access to credit for investments, lack of land tenure security, limited access to information, and low or no safety nets to protect against shocks (FAO, 2016a). If barriers to adoption are present at the household or individual level, the capacity to manage risks and engage in diversification will be limited.

Both vulnerability and risk are heavily linked to diversification as households will make determinations on diversification strategies based on the presence of factors related to these concepts. Much of the available literature classifies a household as vulnerable to falling in to poverty if the likelihood that the household will suffer welfare losses is below the accepted benchmark for wellbeing or poverty levels (Chaudhuri, 2002). When this occurs, smallholder farmers must assess livelihood diversification strategies and adopt a method either ex-post or ex-ante in order to mitigate risks. If decisions are made ex-ante, households will choose an action to reduce risk exposure, such as choosing a strategy option that may have low, but relatively more stable income returns. Ex-post coping strategies are typically the result of inadequate access to financial or insurance mechanisms, and manifest in the form of reduced consumption or asset selling (McCarthy 2016). Analyzing the factors and processes which impact how households cope with climate shocks may lead to a more in-depth understanding of the most successful diversification methods utilized and how they have prevented these households from falling into poverty.

Various approaches have been used to define and measure diversification. As noted, within the context of Malawi, the most prevalent diversification strategies include farm sector activitives – crop diversification, raising of livestock, natural resource-related activities, working on another farm, or non-farm sector work through activities such as wage employment, self employment, transfers, and rents (FAO, 2016a). Diversification can then be measured based on a constructed index which includes land and labor as the two major resources available to rural households. Labor is measured relative to the allocation of time between key working activities, based on gender and age. Land diversification denotes the number of crop species which are planted and the farm areas allocated for each crop during the planting season. Asfaw et al. use a linear regression model to estimate diversification based on endowments of land, household labor, household characteristics and significant push and pull factors

which include climatic variables and diversification strategies (Asfaw 2015). The degree to which a diversification strategy may be adopted to help mitigate risk depends significantly on the endowments of the household and the household's tolerance for risk.

In this regard, again, push and pull factors are essential in understanding the motivations for diversification at the household level. Households or individuals employ diversification as a risk-management or "shock-coping strategy" in response to push factors. If a household is influenced by push factors, this is likely occurring in the presence of deteriorating agriculture or livelihood conditions and is likely a means of avoiding distress which will result in lower income returns. However, if a household diversifies based on pull factors, these are more often linked to either commercial agriculture or more rewarding labor market opportunities, and thus have a higher likelihood of greater returns (Dimova 2010). Households at varying ends of the wealth distribution are motivated by these factors which influences both diversification outcomes and poverty levels. Understanding whether or not decisions to diversify are motivated by either push or pull factors can aid in determining how households are influenced at varying income levels.

Finally, an analysis of the asset-based vulnerability concept (VEP), put forth by Carter and Barrett (2006), highlights the importance of evaluating household assets and the impact of these assets on diversification strategies. Further developed by Chaudhuri et al. (2002) and Calvo and Dercon (2003), the asset-based vulnerability concept estimates household assets and their returns in order to assess the overall wellbeing of a household. The concept of vulnerability is linked to asset holding and is used as an indicator for predicting poverty since it points to the economic exposure which is created by a lack of value assets. The core idea of VEP is to allow researchers to produce a measure capable of forecasting ex-ante level poverty while taking in to account the role that risk and uncertainty play (Asfaw 2015). By reviewing these concepts and links, this study will build upon the previous work of others in the examination of diversification strategies in Malawi and determine which factors are most prevalent for those households which fare better economically post climate events.

Chapter 2 – Methodology

Building on the theoretical framework, this study examines the differences in wealth outcomes for households across the income distribution in rural Malawi following a climate event. This section describes the data used for this study as well as the key variables analyzed and household characteristics present for the surveyed population.

2.1 Data sources

For the purposes of this study, two types of data are used. The first data set comes from cross sectional, household panel survey data collected across Malawi. The 2013 Malawi Integrated Household Survey Panel (IHPS) is a sample survey which is administered every three years and targets households, individuals, and communities in districts in Malawi. The second set of data comes from the EM-DAT International Disaster Database. The data compiled from the 2013 Malawi IHPS survey includes both socio-economic and agricultural data. The survey uses a nationally representative stratified sample which collects information on household make-up, characteristics, socio-economic status, agricultural activities, self-reported impact of shocks, and coping responses. The sample includes a total of 3,000 households at the regional and district level. For the purposes of this study, only those households which were located in rural areas and engaged in some form of agricultural activities are included, which includes a sample size of 1,255 households. The household data used is panel data with assigned household level identification codes used to track at each survey period. Households and individuals included in the survey were administered both household and agriculture questionnaires.

The climate variability data comes from the Emergency Events Disaster Database (EM-DAT) which collects data on global weather events. The database was created with support from the World Health Organization (WHO). The information is collected from various UN agencies, non-governmental organizations, insurance companies, research institutes, and press agencies (EM-DAT 2019). The data is categorized by region, date, disaster type, and disaster sub-type. For this study, the natural disaster types evaluated were droughts and floods which occurred during the period between 2012 and 2016. Floods are classified as hydrological events, whereas droughts are climatological.

Within the flood event data both the flash floods and riverine floods sub-groups are included. During the targeted study period, households across districts in the northern, central, and southern regions were all impacted by natural disasters or climate shocks. Particularly, between 2013 and 2015, 23 out of 25 districts experienced an extended drought or flood (EM-DAT 2019). The IHPS3 survey data includes geographical location information at the household and EA levels which allows for merging of the household and climate-shock data. The data was combined with geo variables from the household survey to identify those households which were located in regions impacted by climate shocks. Based on the severe climate events reported by EM-DAT which occurred during the 2013 growing season, the study is focused on this survey period in order to measure household wellbeing.

The data included from the agricultural household survey offers useful information related to household crop diversification, planting activities, plot sizes, labor and time allocation, and farm inputs utilized such as fertilizer, pesticides, or herbicides. The agricultural questionnaire was administered during the same time period and merged with the household survey data. Households which had planting seasons during the rainy season which consisted mainly of maize where considered less diversified and those households which allocated plots to crops such as tobacco, groundnut wheat, sugar cane, or ground bean were considered diversified. Finally, data regarding ownership of livestock was included in the analysis in order to determine household wealth and assets. The ownership, production, or sale of livestock are essential features for household wealth and indicate past and future well-being. Particularly within this study, data on livestock was collected from the IHS results and used as a dummy variable to indicate whether a household currently owned livestock.

2.2 Household level data

Table 1 highlights descriptive statistics for community and household data across rural Malawi, separated by region. Key descriptive variables included from the 2013 panel data are household consumption, head of household gender, age of head of household, household size, highest education level achieved, and marital status. Of the sampled households, it was found that the average age of

household heads is 44 years old. Males were dominant head of household with nearly 75% of households led by men. The average household size was about 5 members. Nearly 56% of household heads have no education, and about 77% of household heads were married. The sample data highlights that those households below the poverty line held nearly the same plot sizes as wealthier families. Average land ownership is approximately 1.71 acres for poor households as compared to 1.97 acres for wealthier households. Approximately 60% of the households' own livestock, while the average aggregate consumption totals show that nearly 31% of the sample lives below the poverty line of MWK 85,852 per year (2013 prices). As highlighted in previous studies, households with greater wealth likely have higher production and income strategies which could be more lucrative but also involve greater risk (McCarthy 2016). The household data by poverty levels also indicates that wealthier households had more access to credit and higher supplemental income sources.

2.3 Methodology

Using quantitative methods, this study analyzed household and climate variability data to identify patterns and links between climate shocks, income diversification, and poverty levels. Within this context, poverty (π) is affected by income diversification, denoted by β (which captures non-agricultural business ownership and crop diversification), climate shocks (γ) (which includes floods, droughts, and irregular rains), as well as various other control variables such as household size, age, plot size, female headed household, marital status, and education (z). Thus, in a simple ordinary least squares regression, poverty can generally be expressed with the following equation

$$\pi = \alpha + \beta + \gamma + z + e \quad (1)$$

Poverty as an indicator for welfare is typically measured through the aggregate consumption indicator at the household level. This measure is comprised of food, nonfood expenditures, and total purchases. In particular, food consumption is a useful measure for indicating how a household is managing in relation to the national poverty level. According to most studies, food consumption per

capita provides the best indicator for identifying households which may be vulnerable to poverty due to underreporting on income figures (McCarthy 2016). By using food consumption per capita, households are much more likely to report on this data and thus studies are better able to capture welfare and understand the links between maize production and food security (World Bank, 2007). However, the National Statistical Office of Malawi provides a baseline calculation for total consumption and poverty rate estimates. This data is based on the sum of food and non-food poverty lines. To calculate poverty, an average consumption figure is collected per household**.** Those households below the MWK consumption per capita, per year threshold are considered those living in poverty. For 2013, the poverty lines per person per year were according to those figures estimated by the World Bank presented in table 2 below. It is important to note, however, that the poverty rate found in the survey sample does not match the country poverty rate. Due to the survey size and stratified sample selection, the sample captures the lower bound for actual poverty in Malawi (World Bank 2015). Here, the study found 31% of households to be under the 2013 poverty line, whereas the national poverty rate was estimated at 50.7% of the total population.

Table 2: Poverty line estimates per person per year

	Malawi 2013 prices
Food	53,262
Non-food	32,589
Total	85,852

Note: World Bank estimate, 2015

To estimate diversification, the study included data on both crop diversification and non-agricultural business ownership. The variables used to measure crop diversification include data on both maize crop diversification and non-maize crops. Those households which planted varied maize crops such as local, OPV, and hybrid maize seeds, while this is a type of diversification, are considered non-diversified. Any household which planted crops such as tobacco, rice, groundnut, bean, sweet potato, wheat, or sorghum were considered to have diversified farms. Additionally, the survey captured data on households which were involved in non-agricultural businesses such as owning a trading business on the street or in a market, household shop business, professional office or professional service, driving

a taxi, or owning a bar or restaurant. It was found that there was a significantly higher percentage of households with diversified crops planted then the proportion of households which had diversified income from non-agricultural businesses. Both poor households and those wealthier households had similar rates of crop diversification but differed considerably in other income diversification methods.

Households which were located in regions found to have undergone a climate shock were substantiated through both the disaster data which identified regions where floods and droughts had taken place, in addition to results from the household survey which collected data on whether or not a household had undergone a shock. A dummy variable was created to measure those households which responded positively to this inquiry and noted which shock event had impacted the household. Results indicating households impacted by a drought or flood by district are presented in figure 3. Here the data shows that the northern region of Malawi had the highest occurrence of households which reported impact from both droughts and floods. Climate shocks in the form of a flood were the most frequent weather event impacting households in the central region, however for this district only 65% of households reported experiencing a drought. In addition to linear regressions using consumption as the dependent variable, interaction terms for floods and drought with income diversification were used to identify further impact when these variables are combined. Across Malawi, the incidence of households which were impacted by climate shocks is relatively high with 70% of households experiencing a drought and 89% reporting flood impact during the survey period.

Further, models (2) and (3) were run as single-equation instrumental variable regressions and adapted to include instruments for income diversification. The second model includes the approximate distance of a household to the nearest agricultural market as an instrument for income diversification. The use of this instrument works to capture the potential endogeneity of access to market with income diversification and remove possible omitted variable bias. It is likely that those households which have increased access to agricultural markets might also display factors such as higher property values relative to proximity to market, improved road conditions, stronger social and community networks, and better access to social services. These variables while not present in the regression model could

have significant impact on a household's ability to successfully diversify. By including distance to market as an instrument for income diversification omitted variable bias can potentially be avoided.

The third model uses both distance to agricultural markets and social safety nets as joint instruments for income diversification. The addition of safety net access is an important indicator of how households with this support protection differ from those without it in relation to income diversification. Here, social safety nets includes factors such as free maize, direct cash transfers (both from government and NGO or development partners), public works, and school feeding programs. Further, by including social safety nets as an instrument, the model again captures the potential endogeneity of this variable and omitted variables related to income diversification. The presence of safety nets for households could potentially be linked to the location and proximity of their household to the nearby markets. It is likely that agricultural markets in rural areas are also closely connected with important social hubs where the population density is higher and thus there is more access to information and services. These expanded information and access channels can have positive impacts on a household's ability to improve financial outcomes and diversify income sources.

As noted, after investigating the factors most associated with income diversification, the additional models use flood and income diversification and drought and income diversification interactions to look for compounded impacts on household welfare. By examining the impact of flood or droughts on income diversification, the study focuses on the role of climate shocks in interaction with diversification strategies in order to determine both household vulnerability and the effect on consumption. Prior studies have shown that climate variability can have a direct impact on household diversification. In a study conducted by Asfaw et al, it was found that consumption is influenced by climate variability through diversification and on-farm income such as yields and prices (Asfaw 2015). Therefore, by including interaction terms within the regression model, the analysis should reveal how diversification levels differ in the presence of climate shocks and how this impacts consumption or wealth outcomes.

It is important to note that the data used and the results have some limitations. First, the survey sample size while selected using stratified sampling techniques in order to maintain randomization, is

relatively small in comparison to Malawi's total population size. This is evident by the lower bound of the poverty rate captured in this sample (31%) when compared with the national poverty rate for 2013 (50.7%). Based on the small survey size, it is possible that the results are less generalizable to the overall population, and in addition, incidences of low access to credit, safety nets, and additional income could be much lower for this population when accounting for actual poverty levels. Further, the potential presence of unobservable indicators which might influence household consumption and opportunities for diversification could bias the results. The instrumental regression model attempts to avoid some of this bias with the inclusion of distance to agricultural markets and safety nets, however, other variables such as rainfall variability, community networks, and behavioral patterns and responses could also have a significant effect on methods of diversification. Future studies can overcome these limitations by potentially studying a larger sample and adopting robustness tests in order to enhance the results. The following section reviews the results of the study and discusses the findings.

Chapter 3 – Results and Discussion

Results from the OLS regression equations are presented in table 4. The results show that the coefficient for consumption levels has a positive relationship with income diversification, livestock, plot size, education, smaller household sizes, and shorter distances to market. This likely indicates that households which are more diversified are also wealthier due to many of the variables which were added as controls within the model. Thus, higher levels of diversification are associated with higher household consumption which is used to measure poverty or wealth. The relationship between consumption and income diversification is significant at the 1% level. The results seem to reveal that wealthier households are better able to diversify away from maize crops and instead invest in non-maize or non-agricultural activities. While the first model shows a significant correlation between income diversification and consumption, crop diversification is much less positively correlated with consumption. As previously indicated, most poor households opt for crop diversification as a mitigation strategy, based on feasibility and barriers to access. This could underline the differences in wealth generating outcomes which are possible between these two diversification strategies. As crop diversification is often used as a shock mitigation strategy by poor households, it is not shown here to have significant positive impacts on these households' livelihoods.

Interestingly, a review of the descriptive statistics for poor versus non-poor households in table 3 indicates that the differences between these two groups in most instances are not always largely significant, except for in those categories that indicate wealth and wellbeing. Household size differs by two family members at 4.50 for non-poor households and 6.37 for poor households. However, a review of the regression output shows that smaller household size is significant and with a negative coefficient to the dependent variable consumption in both instrumental variable regressions. This result differs from previous studies which have generally found household size to have positive impacts on household diversification and consumption. In most cases, a large family size based on adult-equivalency indicates more labor supply for income supplementation both on and off the farm. In regards to education, the data also shows that household heads with no education occur in higher incidence in those households with lower wealth, and the regression results indicate that this variable is again significantly correlated

with consumption and associated with a negative coefficient. The results for female headed households are also significant at the 1% level and associated with a negative coefficient to dependent variable. This means that the higher the occurrence of female heads, the lower the household consumption level. The results support previous findings in that other studies have also found that female-headed households often displayed constraints on off-farm labor supply due to household labor requirements which negatively impacted household consumption (Asfaw 2015).

The results highlighting positive coefficients for livestock ownership and plot size are also indicative of the difference that these factors can make in how successful a farming household is in its mitigation efforts. While the results for plot size are positively correlated with consumption and significant, the coefficients are low, likely due to the small difference in average plot sizes between poor and non-poor households. However, the descriptive statistics in table 3 show an important difference in the minimum and maximum plot sizes measured in acres for these households. By comparison, the maximum acres of land for non-poor households is 15.25, whereas the same value for poor households is 11 acres. This difference in available land for crop planting can have substantial impacts on a household's earning potential during growing season. It is also fundamentally important when considering the average larger household sizes for poor versus non-poor households. Households which must divide land between household members will have much less land to allocate. This realization points to earlier findings regarding diminishing farm sizes in relation to a growing population.

The results for interactions between either flood or drought and income diversification suggest a significant relationship and also have a positive coefficient. With respect to climate variability and the interaction terms utilized to measure the impact of weather shocks on diversification, the results show positive coefficients related to the dependent variable indicating consumption. The share of those households impacted by climate events such as droughts or floods is measured at over 70% of the population. Thus, when examining the correlation of these events when compared with consumption, the results do not appear to be significant. However, using the interaction between climate shocks and income diversification, shows that those households which were diversified at the time of a climate

shock, had higher levels of consumption or wealth. Both interaction terms when regressed, showed results with positive coefficients and were significant at the 1% level. Across all models, households which owned livestock, held larger plot sizes, and had fewer household members, and lower rates of no education, were positively correlated with higher consumption levels. Additionally, for those rural households which were impacted by climate shocks, those categories related to income such as diversification, safety net access, credit received, and cash transfers, the data showed a higher percentage across non-poor households than poor households. The differences while not vast are indicative of the small sample size used for this study and could potentially point to the characteristics of the larger population.

The regression in table 5 which uses both distance to market and safety nets as an instrument for income diversification produces the strongest results and, also shows a significant correlation between these variables and consumption. It is likely that the addition of safety nets at the household level improves diversification outcomes. Although the model highlights correlation, the analysis is not yet strong enough to prove causation. There are potential variables such as household endowments apart from additional income sources and safety nets which might also influence diversification methods and financial improvement. However, both the joint equation instrument variable regression and the OLS regressions point to the presence of diversification methods positively contributing to higher consumption level in wealthier households. The second instrumental model uses only safety net as an instrument and returns much weaker results and correlation to the dependent variable. A further review of the percentage of non-poor households which had access to safety nets, indicates that these households had a slightly lower occurrence of this variable present than poor households. However, it appears that when linked with distance to market, the effect becomes much stronger.

A deeper analysis of safety net coverage for the study sample, presented in figure 3 shows that overall the most common safety net types were the school feeding program, in-kind free food assistance, free maize, and the public works program. The occurrence of those households which received some form of safety net was present in only 38.73% of the sample survey. The data also highlights that poor households had only a slightly higher incidence (40%) of safety net access than those households which

were non-poor (38%). The differences lie in the types of safety net received by these populations since free maize programs are much more common among poor households, in contrast to wealthier households which were more likely to receive cash transfers. These findings are further supported by a study conducted by the International Food Policy Research Institute (IFPRI), which analyzed integrated household survey data from 2010/2011 and found that although households from the poorest segments of the population were three times more likely to receive an in-kind food transfer and twice as likely to receive a direct cash transfer than a household in the richest segment, in practice, 73% of households in the poorest segment did not receive the safety net benefit while 9% of rich households did (Duchoslav 2018). The evidence suggests that although most safety net programs in Malawi are skewed toward support of the poorest households, the targeting mechanisms used are highly inaccurate and ineffective.

While the poverty rates for this sample are 31% poor versus 68% non-poor, there is a stark difference in the consumption levels per capita and income from additional sources for these two groups as shown in table 3. Non-poor households, on average, had consumption rates at over twice as much as poor households and had income from additional sources which is three times as high as those poorer households. Access to additional income sources, in addition to more access to credit or cash transfers can form a sort of individual safety net for households seeking to diversify. The inclusion of safety nets is an important indicator as it points to the added benefits for households with access to social support when attempting to diversify. Previous studies conducted by Duchoslav and Kenamu found that current safety net programs within Malawi, have had significant difficulty both targeting the poorest households and reaching those households with assistance (Duchoslav 2018). Analyzing data from previous Integrated Household surveys conducted in Malawi, the researchers found that in actuality, even in those programs where the poorest segments were targeted, input and subsidy programs primarily reached middle wealth segments of the population instead. These results help strengthen the findings here that those households with higher consumption levels also benefited when income diversification and safety net access were present.

Previous studies have also found that household size, education, ability to access non-farm employment, proximity to markets, and access to efficient roads are all key determinants of the

incidence of poverty in Malawi (ILO n.d.). All of these factors appear in lower quantities for those poor households sampled within this survey. Without improvement in these areas, poor households will continue to experience vulnerability to shocks and likely fall deeper into poverty. Particularly, as issues surrounding land constraints, low technology adoption, and low asset accumulation continue to impact this population. Thus, those districts with significantly poorer households must have improved access to social safety net programs which could potentially improve a household's ability to invest in diversification strategies. Even those households which attempt to diversify by searching for non-maize income, may eventually decide to return to maize production as a "safety-first approach" in order to ensure that their food stores remain secure (Sesmero 2018). Hence, the results of this study have indicated that poor households have less opportunity and success diversifying income sources as a result of having lower access to social safety nets such as credit, additional income sources, and cash transfers.

Chapter 4 – Conclusion and Policy Recommendations

As Malawi households are increasingly impacted by deteriorating weather conditions, it will become even more crucial for those households which are most vulnerable to have access to income strategies which can help mitigate shocks. This study has analyzed the relationship between climate shocks and income diversification, and used quantitative analysis to investigate the impact of these variables on household consumption and wellbeing. The data and analysis presented within this study indicates both the importance of a household's capacity to diversify as well as the necessity of household access to social safety nets. Although the sample included in this study is a small representation of the overall population, the data highlights the bleak differences in essential characteristics between poor and non-poor households, particularly in light of projected population growth in the coming years. It also demonstrates the differences between household access to credit, markets, and safety nets at varying income levels. Thus, the findings indicate that those households which are lower on the wealth distribution also have lower rates of diversification and disproportionate access to safety net programs.

Studies conducted by the Malawi Economic Monitor (MEM) and ILO stress the required commitment of the Malawi government to reallocate financing toward programs which will strengthen safety nets. Evidence from international case studies indicates that increased investments in social protection mechanisms have been effective in reducing poverty rates and inequality, while also promoting a more inclusive economy and spurring growth (ILO n.d.). Social protection programs such as cash transfers, school meals, and public works are important tools which can be used to prevent households from descending further in to poverty. Programs like the Social Cash Transfer (SCT) have so far only reached a small number of households and do not support the vast majority of poor children, disabled, chronically ill or elderly who do not reside in these households (ILO n.d.). While the government has initiated various programs aimed at targeting agricultural production, these have been less successful and have not been shown to substantially improve smallholder farm productivity or output.

Safety net programs like the Food Insecurity Response Plan (FISP), which provide in-kind food assistance or direct cash transfers to poor households during the lean season, have also been shown to severely under target the poorest households. Within the survey data analyzed for this study, the incidence of households which receive cash transfers either from government agencies or civil society was lower for poor households than non-poor households. Although similar studies have found this type of safety net coverage has increased over the years for the total population, the programs do not exclusively target poor households. This indicates that households which already have advantages from higher consumption, more land, and better access to markets, may also gain added benefits from access to safety nets which are meant for the poorest households.

Encouragingly, some progress has been made with programs initiated by the World Bank and the Government of Malawi, with the institution of the Drought Recovery and Resilience Project in 2016, to help support the government of Malawi in meeting the food security and livelihood needs of its population. The aim of the project is to provide financial assistance in the recovery of the Malawi economy which have resulted from consecutive poor agricultural seasons, impacting over 6 million people and leaving them unable to meet their food requirements after the 2015 and 2016 growing seasons (World Bank 2016). The Malawi Vulnerability Assessment Committee estimates the economic damage from poor growing seasons at USD $500 million. Thus, the recovery efforts of the World Bank and Malawi government are a necessary response to years of low agricultural productivity which have been impacted by worsening climate shocks. As part of the proposal, the MEM recommends the reallocation of financial resources away from initiatives like fertilizer subsidies which have been much less in alleviating household poverty. In addition, in order to successfully break the cycle of poverty in Malawi, the MEM report also recommends better targeting of the poor, improvements in program design, and stronger delivery systems which can be used to deliver social safety nets. Although some of these new programs have been initiated, coverage rates and targeting of vulnerable households continues to prevent substantial progress in reducing poverty levels.

Considering this analysis, policymakers have significant opportunity to address stagnant poverty rates in Malawi by not only implementing the above recommendations proposed by the MEM

and World Bank but also substantively renewing commitments to invest in social protection systems and realigning these goals as priorities within the national agenda. Moreover, by developing a more comprehensive understanding of the factors which influence poverty rates, policy makers can more effectively promote safety net programs which will allow for increased coverage of the most vulnerable households, while also providing support for those households which strive for diversification. In the face of worsening climate change, it is critical that Malawi work to break the cycle of poverty by improving its current social package and expanding coverage to those households which are most vulnerable.

Appendix

Table 1. Descriptive statistics by region 2013

	Malawi		Northern		Central		Southern	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Household demographics								
Age of household head (years)	43.88	16.46	47.94	15.49	43.8	16.47	43.07	16.54
HH Head is Female	0.256	0.436	0.275	0.448	0.202	0.402	0.302	0.496
HH Head is Married	0.771	0.420	0.741	0.439	0.81	0.38	0.737	0.440
HH Head Education	0.561	0.496	0.620	0.487	0.54	0.498	0.565	0.496
Household size	5.10	2.30	5.66	2.73	5.20	2.35	4.89	2.13
Welfare Measures								
HH Total Consumption	143245.9	107188.6	121934.5	70300.93	151292.1	116063.1	139968	103958.7
HH Food Consumption	87058.88	61131.1	78304.25	39875.92	91839.17	63962.77	84344.74	61612.22
Additional Income	12018.87	78451.76	27048.71	73929.67	8253.376	42842.48	12560.37	101273.8
Conditional Transfers	0.009	0.097	0.017	0.131	0.003	0.060	0.014	0.116
HH Safety net	0.387	0.487	0.155	0.364	0.281	0.450	0.531	0.499
Plot Size (acres)	1.89	1.65	1.51	1.42	2.24	1.81	1.64	1.46
Shocks								
Floods	0.893	0.309	0.957	0.204	0.938	0.241	0.840	0.368
Drought	0.708	0.455	0.862	0.346	0.715	0.452	0.670	0.471
Diversification								
HH Income Diversification	0.268	0.442	0.095	0.294	0.290	0.454	0.281	0.450
HH Crop Diversification	0.815	0.388	0.681	0.468	0.797	0.402	0.857	0.349
Livestock (avg owned)	1.46	0.704	1.32	0.849	1.47	0.796	1.48	0.571
Livestock (percent by HH)	0.614	0.487	0.56	0.498	0.616	0.486	0.620	0.485
Observations	1,255		116		547		591	

Notes: Consumption and additional income shown in MWK figures as of 2013 purchasing prices. Compared to the national poverty level, the poverty line is at less than MWK 85,852 per person per year.

Table 3. Descriptive statistics by poverty level

	Non-poor households					Poor households				
	Obs	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max
Household demographics										
Age	855	43.51	16.95	17	113	399	44.68	15.33	18	104
Education (none)	856	0.542	0.498	0	1	399	0.604	0.489	0	1
HH Head is Female	856	0.248	0.432	0	1	399	0.273	0.446	0	1
Marital status	856	1.81	1.46	1	6	399	1.89	1.48	1	6
Household size	856	4.50	2.06	1	16	399	6.37	2.29	2	17
Income										
Income diversification	856	0.295	0.456	0	1	399	0.208	0.406	0	1
Crop diversification	856	0.832	0.374	0	1	399	0.789	0.415	0	1
Consumption per capita	856	181623.9	109932.7	85901.1	940341.4	399	60910.98	16566.63	15163.86	85842.55
Total additional income	856	15789.93	94072.25	0	2365000	399	3928.571	16870.83	0	200000
Safety net	856	0.381	0.486	0	1	399	0.401	0.491	0	1
Credit received	856	0.229	0.420	0	1	399	0.197	0.399	0	1
Cash transfers	856	0.012	0.107	0	1	399	.005	0.070	0	1
Shocks										
Drought	856	0.723	0.447	0	1	399	.674	0.469	0	1
Floods	856	0.894	0.308	0	1	399	.892	0.310	0	1
Livestock	856	0.640	0.480	0	1	399	.559	0.497	0	1
Livestock (qty)	547	1.43	0.601	1	7	223	1.54	0.902	1	10
Community demographics										
Plot size (acres)	856	1.98	1.78	0	15.25	399	1.71	1.33	0	11
Distance to market	856	25.97	13.69	1	59	399	28.09	13.33	2	67
Distance to population center	856	34.64	16.79	1	97	399	36.61	17.61	2	93

Notes: Consumption and additional income shown in MWK figures as of 2013 purchasing prices.

Table 4. Effect of income and crop diversification on household consumption

	Consumption	
	(1)	**(2)**
Income diversification	0.224***	
	(0.0347)	
Crop diversification		0.0654
		(0.0403)
Drought	0.0469	0.0499
	(0.0337)	(0.0342)
Floods	0.00416	-0.00957
	(0.0502)	(0.0510)
Livestock	0.183***	0.192***
	(0.0323)	(0.0328)
Plot size	0.0608***	0.0585***
	(0.00982)	(0.0100)
Age	-0.000951	-0.00145
	(0.00100)	(0.00102)
HH Head Education	-0.0585*	-0.0559*
	(0.0304)	(0.0309)
HH Head Female	-0.149***	-0.163***
	(0.0516)	(0.0526)
Marital Status	0.0167	0.0170
	(0.0160)	(0.0163)
Household size	-0.139***	-0.136***
	(0.00698)	(0.00708)
Distance to market	-0.00649***	-0.00679***
	(0.00131)	(0.00133)
Safety net	0.0169	0.0338
	(0.0330)	(0.0334)
Cash Transfers	0.0575	0.0398
	(0.156)	(0.159)
_cons	12.39***	12.39***
	(0.110)	(0.115)
Observations	1254	1254
R^2	0.301	0.279

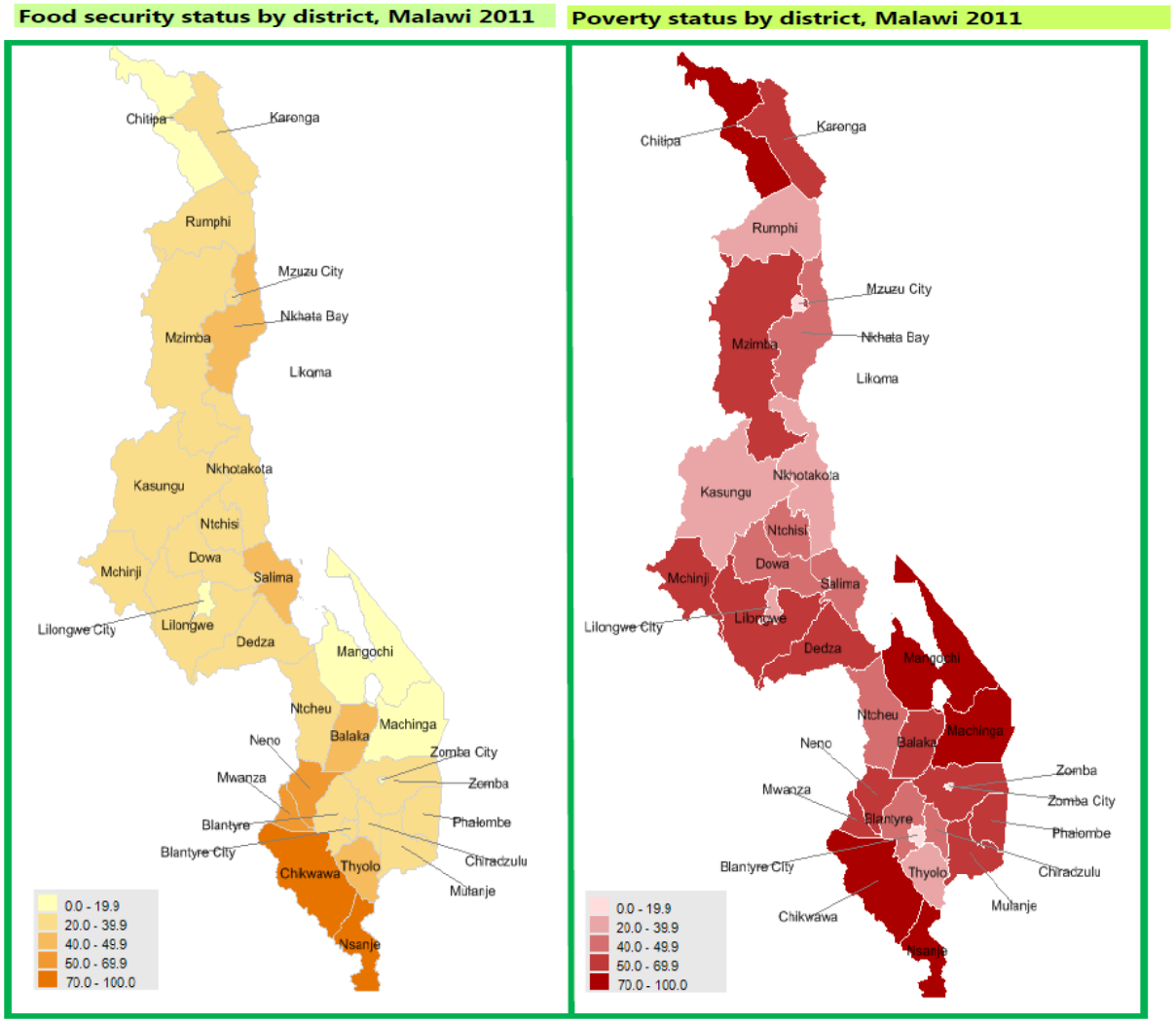
Notes: OLS regression. Table reports coefficient and related p-values are in parenthesis. Significance levels indicated by asterisks: *p<0.10, **p<0.05, ***p<0.1.

Table 5. Effect of income diversification on consumption: instrumental variable regressions

	Consumption			
	(1)	**(2)**	**(3)**	**(4)**
Income diversification	1.116**	0.513		
	(0.486)	(0.428)		
Floods	0.0938	0.0595	0.0465	-0.0306
	(0.0672)	(0.0565)	(0.0501)	(0.0512)
Drought	0.0300	0.0353	-0.0333	0.0395
	(0.0419)	(0.0349)	(0.0359)	(0.0341)
Livestock	0.131***	0.168***	0.188***	0.185***
	(0.0496)	(0.0422)	(0.0326)	(0.0327)
Plot size	0.0630***	0.0609***	0.0615***	0.0590***
	(0.0123)	(0.0102)	(0.00992)	(0.00993)
Age	0.00100	-0.000256	-0.000916	-0.000925
	(0.00160)	(0.00136)	(0.00101)	(0.00101)
Education	-0.0759**	-0.0649**	-0.0548*	-0.0595*
	(0.0386)	(0.0322)	(0.0307)	(0.0307)
HH Head is Female	-0.113*	-0.129**	-0.134**	-0.135***
	(0.0650)	(0.0543)	(0.0520)	(0.0521)
Marital status	0.0261	0.0198	0.0155	0.0151
	(0.0204)	(0.0171)	(0.0162)	(0.0162)
Household size	-0.151***	-0.144***	-0.140***	-0.139***
	(0.0103)	(0.00876)	(0.00699)	(0.00700)
Drought * income diversification			0.262***	
			(0.0415)	
Flood * income diversification				0.222***
				(0.0372)
_cons	12.00***	12.10***	12.20***	12.22***
	(0.145)	(0.123)	(0.0991)	(0.0994)
Observations	1254	1254	1254	1254
R^2	-0.083	0.250	0.285	0.283

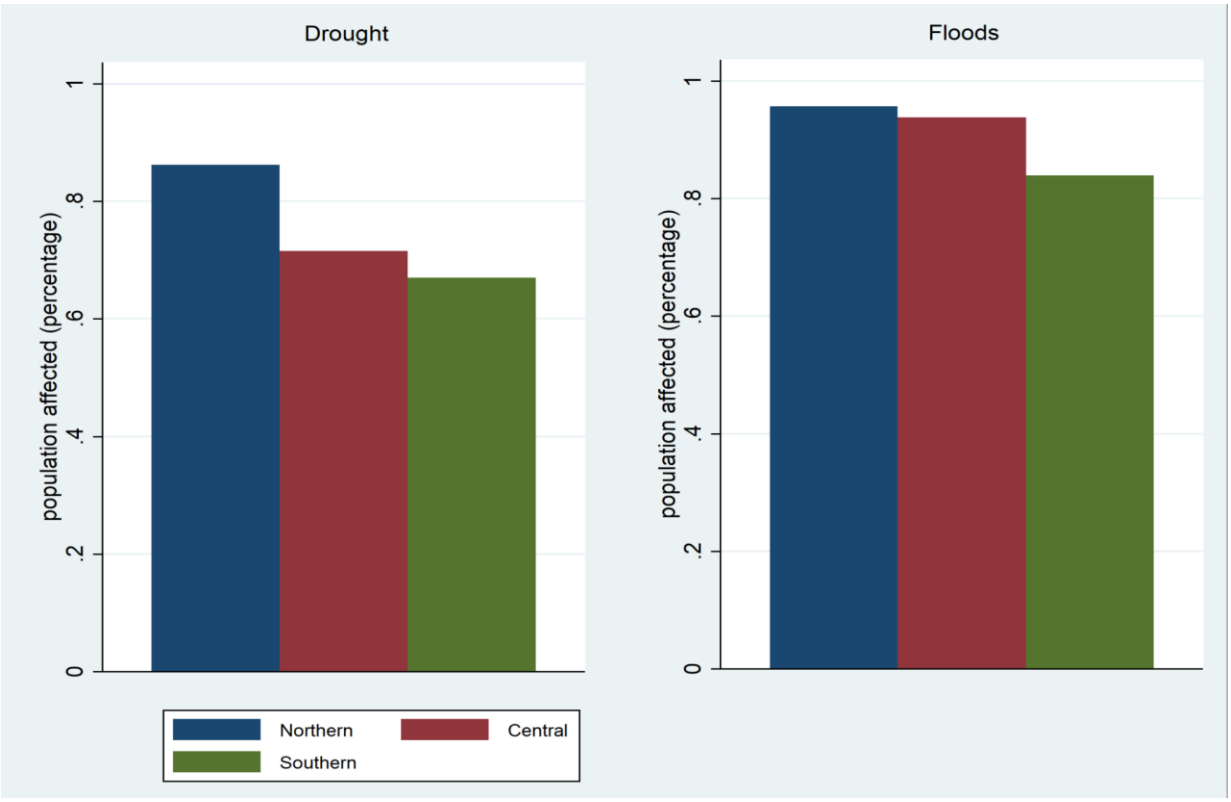
Notes: IV regressions model (1) uses distance to market and household safety net as instruments for income diversification. Model (2) uses only household safety net as the instrument for income diversification. Models (3) and (4) are OLS regressions including interaction terms. Table reports coefficient and related p-values are in parenthesis. Significance levels indicated by asterisks: *p<0.10, **p<0.05, ***p<0.1.

Figure 1. Malawi poverty and food security map



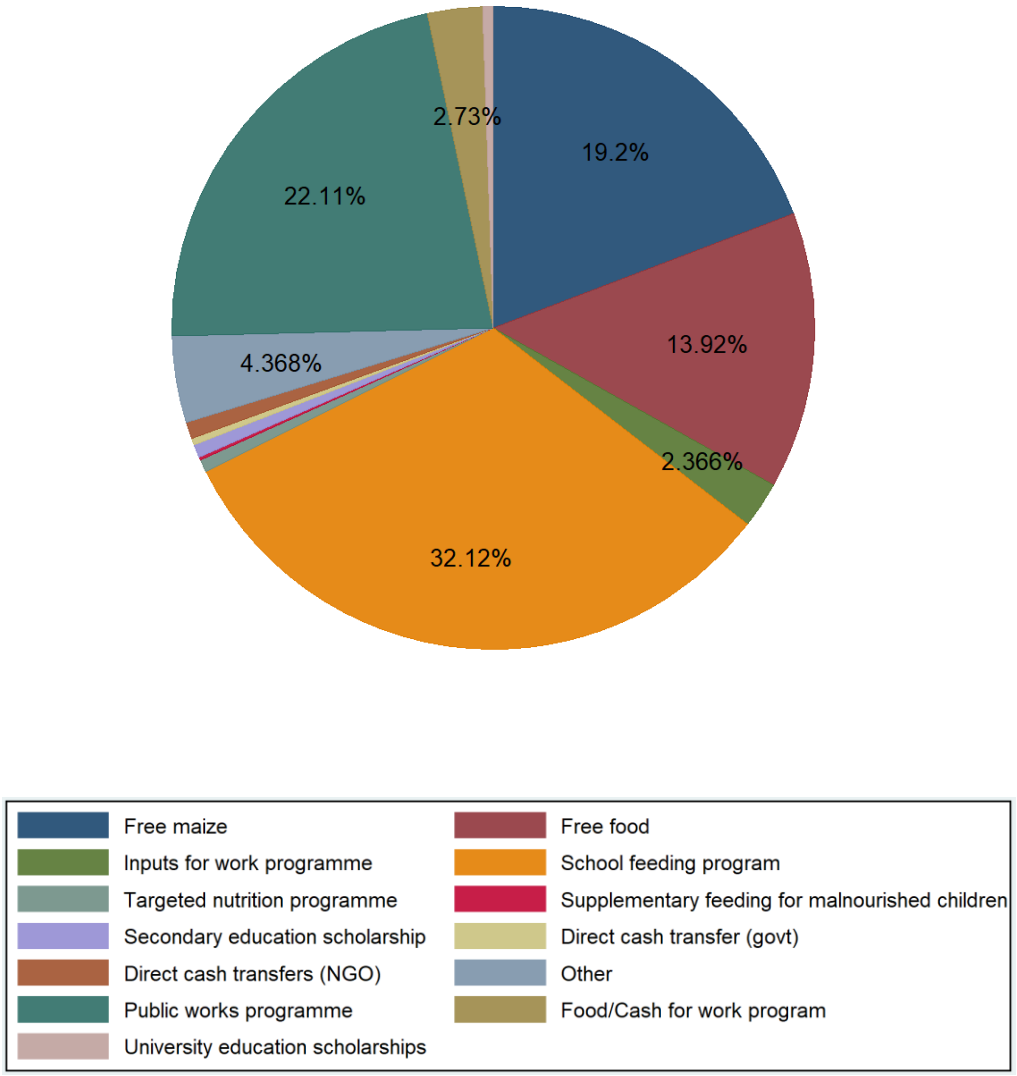
Notes: IHS3 Report. Republic of Malawi, 2013

Figure 2. Climate shocks by region



Notes: Climate shock impact results based on the 2013 Malawi Integrated Household Survey.

Figure 3. Safety net distribution by type



Notes: Graph shows the percentage of safety net types received for the total survey sample.

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