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Predictors of food insecurity in Eswatini: Lessons from the 2015/16 El Niño induced drought

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Abstract

The study investigates the predictors of food insecurity among households in Eswatini given the 2015/16 El Niño induced drought. To identify the geographic and socioeconomic factors that predict food insecurity during a drought in Eswatini, the study uses a logistic regression. The logistic regression results show that households that have a deteriorated health and disability status are three times more likely to be food insecure during a drought than households that have no health or disability impacts. In contrast, high quality vegetables, meat, and fish can be considered luxury food items that significantly predict food security among households in the country. The study also finds that the prices of maize and rice are good predictors of food insecurity among households given that maize is a staple food in Eswatini. A major finding on the predictors of food insecurity is that all incomes above E1,000 significantly reduce the chances of food insecurity among households compared to those households that have no form of income. The regression reveals that E3,500 is the optimal level of monthly income to cushion households from severe food insecurity. Therefore, the study recommends that Government (Ministry of Labour and Social Security) should investigate the suitability and sustainability of a E3,500 monthly minimum income (wage) in Eswatini. Furthermore, in the event of drought, the Government of Eswatini should prioritise intervention programmes such as food distribution on households living with disabilities and those with deteriorated health status. In terms of building drought preparedness and mitigation for future droughts, implementation of the 2005 Food Security Policy should deliberately target the following constituencies; Lomahasha, Mthongwaneni, Matsanjeni North, Ngudzeni, Sigwe, Hlane, Mandlangempisi, Sandleni, Mkhiweni, Sithobela, Ntontozi, Lubuli, Dvokodvweni, Mayiwane, Siphofaneni, Mafutseni, Ndzingeni, Mahlangatane, Matsanjeni South, Mahlangatja, and Nkwene.

Keywords: Drought; Food Insecurity; Predictors; Food Insecurity Vulnerability.

1. Introduction

Droughts are a constant threat to food security. In developing countries, (Swaziland now known as Eswatini included), droughts rank as the single most common cause of severe food shortages and natural trigger of malnutrition and famine (Food and Agriculture Organization of the United Nations (FAO), 2011). On a global context, food insecurity affects 870 million people and two-thirds of these people are in Sub-Saharan Africa, India, and China (Fyles and Madramootoo, 2016; FAO *et al.*, 2012). According to the 2017 Africa Regional Overview of Food Security and Nutrition Report, Sub-Saharan Africa accounts for 31% of the population affected by severe food insecurity, which is also nearly half of all severely food insecure people in the world (FAO, 2017).

Generally, knowledge on the drivers of climate change and how it contributes to food insecurity is well documented. It includes poverty, food production systems, food prices, rising food demand as a result of population growth, land degradation and water scarcity, biofuel production, and lack of public and private investments in infrastructure (Fyles and Madramootoo, 2016; Porter *et al*., 2014; Thornton *et al*., 2011). The point is, as the Sub-Saharan region experiences more climate change variability with frequent hazards such as El Niño induced droughts, agricultural production will face daunting challenges which will inevitably compound the drivers of food insecurity vulnerability in the region. Literature is conclusive that droughts negatively affect agricultural production, which leads to unstable agricultural incomes against rising food prices that tend to intensify the incidence of poverty and the vulnerability of the poor (Desai *et al*., 1979; Chen, 1991; FAO, 2011; Gustafson, 2013). Shortfalls in food production can cause a rise in prices of food products as food supply diminishes with severe ramifications on the poorest and most vulnerable. Equally, food production deficits can lead to substantial increases in imports to meet local food needs, which can result in a widened trade balance for the importing country (FAO, 2011).

Eswatini is still recovering from the devastating impacts of the 2015/16 El Niño induced drought, which was considered one of worst and strongest since 1950. Besides vulnerability to drought, Eswatini is prone to climate related disasters such as cyclones, flash floods, and windstorms. Of all these disasters, the highest mortality and hardship occurs during droughts (NDMA, 2016; National Disaster Management Policy (DRM), 2010). Consistently, when drought hits Eswatini,

it decapitates the food production system pushing a significant proportion of the population into food insecurity. For example, the Swaziland Vulnerability Assessment Committee Report (VAC) (2016) found that more than half of the population became food insecure as a result of the 2015/16 El Niño induced drought. During the 2015/16 drought, the food insecure population increased by 99% from 320,973 people in July 2015 to 638,251 people in May 2016. Similarly, in 2007, the Office for the Coordination of Humanitarian Affairs (OCHA) reported that approximately 41% of the population (410,000 rising to 610,000 people) required food assistance through the regular programmes of the Eswatini Government and World Food Program (WFP). Again, in 1992 (Eswatini's other major drought within the past two decades), saw 410,000 people or 48% of the population at that time requiring food relief (Herrick and Greene, 1994).

Yet, the Intergovernmental Panel on Climate Change (IPCC) cautions that droughts will occur more frequently, hence, agriculture-based livelihood systems that are already vulnerable to food insecurity face immediate risk (IPCC, 2007). The implication for Eswatini is that yields from rain-fed agriculture could fall by up to 50% by 2020 (IPCC, 2007). Given these IPPC projections on extreme weather conditions into the future, and given the general state of food production deficiency in Eswatini, investments in climate change adaptation and mitigation are much needed to shield the agriculture sector and associated livelihoods from future cataclysmic drought episodes. It is against this backdrop that this study assesses the predictors of food insecurity during a drought situation across the four (4) regions of Eswatini.

Indeed, smallholders and institutions have developed coping mechanisms that attempt to sustain access to food and other basic necessities in the context of frequent natural hazards (Bacon, Sundstrom, and Beezer, 2017). The current literature gap are studies articulating the explanatory theories that link livelihood insecurities (for example, household food insecurity) to the vulnerability context (for example, drought). The predicted frequent natural hazards due to climate change present a challenge to future livelihood coping mechanisms on food security, especially for those households that are currently vulnerable. These strategies for coping with future climate change must be rooted in a full understanding of the complex structure and causes of present-day vulnerability. Reducing food insecurity in Eswatini continues to be priority of national development policy, particularly, the 2006 Poverty Reduction Strategy and Action Plan (PRSAP). For effective targeting of the programmes of the PRSAP

and National Food Policy (2005), information on the location and inherent livelihood vulnerabilities to food insecurity can mitigate the impact of future droughts. Such information can contribute to effective targeting of assistance and interventions on livelihood vulnerabilities to food insecurity. Thus, the study informs policy on priority geographic areas (constituencies in Eswatini) to target these types of interventions and identifies the socioeconomic conditions that need changing for effective drought disaster mitigation in Eswatini.

Specifically, the study identifies the constituencies and socioeconomic factors that significantly predict food insecurity among households in Eswatini. The study uses data obtained from a nationwide study conducted by the National Disaster Management Agency (NDMA) and the Eswatini Economic Policy Analysis and Research Centre (SEPARC) on The Socio-Economic Impacts of the 2015/16 El Niño Induced Drought in Eswatini. NDMA and SEPARC's assessment confirms that Eswatini has been experiencing chronic-drought like conditions since the 1980s, with impacts intensifying in the last decade. The main issue is that, despite a Disaster Risk Management Policy (2010), the country is still struggling to mitigate drought effects. Even with substantial drought experience and knowledge the country has garnered through similar droughts in 2009/10, 2007, 2001, and 1992, the country remains critically vulnerable to drought, particularly on issues of food security among rural households.

2. Drought and Vulnerability to Food Insecurity

As a concept, food security defines a situation when all people at all times have physical or economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996). Generally, food insecurity in Africa and other developing countries is highly correlated with: drought and extreme weather events; pest, livestock diseases, and other agricultural problems; climate change; military conflicts; lack of emergency plans; corruption and political instability; cash-crops dependence; and human diseases and rapid population growth (FAO, 2007; Habyarimana, 2015). The food security status of a household is a multi-dimensional issue that encompasses factors of food availability, accessibility, utilisation, and stability of food systems (FAO, 2008). Food insecurity exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development, and ability to live an active and healthy life. According to the FAO, climate change affects all four dimensions of food security leading to impacts on human health, livelihood assets, food production and distribution channels,

including food purchasing power and market flows (2008). At the national level, food security relates to the availability of food stocks for consumption, be it from own production or from markets and food aid. At the household level, food security is about the ability to obtain sufficient and quality food to meet the nutritional needs of all household members (FAO, 1996; Endalew, Muche, and Tadesse, 2015; Motbainor *et al*., 2016).

Within the Southern African context, food insecurity is an ongoing and persistent problem, and food production per capita is projected to diminish into the future (Motbainor *et al*., 2016; Rosegrant *et al*., 2001). In fact, food insecurity is a prevalent problem that in the past two decades has increasingly been recognised as a serious public health issue (Motbainor *et al.*, 2016). The factors that determine food security can be experienced both at the household and individual level, but also vary spatially across regions (Misselhorn, 2005).

Water is a lubricant of the economy, and without it, droughts disrupt economic activities and sever lifelines for many rural communities who depend on agriculture. Devereux (2007) argues that in rain-fed agricultural systems, erratic rainfall can lead to devastating impacts on livelihoods and local economies. He argues that the immediate impact on rural livelihoods is on crop production. Droughts undermine crop yields cascading to reduced national harvest, which in turn reduce national food availability and agricultural income derived from crop sales. The extent to which poor harvest become a threat to food security and livelihoods from the household to national level depends on the varying degrees that the family or nation depends on agriculture for food and income (Devereux, 2007). However, households and economies that are more diversified are less likely to be vulnerable to the direct impacts of drought provided that their alternative income sources are also not correlated with rainfall nor directly or independently dependent on agriculture (Devereux, 2007).

In Eswatini, almost 80% of the population is rural-based with livelihoods predominantly dependent on rain-fed subsistence agriculture and/or livestock herding (International Funds for Agricultural Development (IFAD), 2013). Smallholder producers constitute 70% of the population and occupy 75% of the crop land, yet contribute a meagre 11% of total agricultural outputs in the country, with average cereal yields as low as 1.1 tonne/hectare (Global Agricultural Information Network (GAIN), 2016; Ministry of Agriculture (MOA), 2016). The large number of people depended on the rural economy, which is dependent on rain-fed agriculture, make drought risk a significant contributing factor to

food insecurity in Eswatini. In the long-term, Dorward and Kydd (2004) assert that the presence of this weather/climate risk lowers the productivity of the rural economy. It does this by reducing returns on agricultural investments, distorting investments away from income-maximising activities towards risk-reduction activities, and by discouraging aggregate investments on agriculture leading to long-run stagnation and rural poverty (Dorward and Kydd, 2004).

Maize remains the important staple food crop grown on Swazi Nation Land for subsistence purposes and food security (MOA, 2016). It is also the measure of food security in the country (FAO, 2005). However, though a substantial number of rural households produce it, the country has never produced enough maize for total domestic consumption (Magagula, Dlamini, and Mkhwanazi, 2007). According to National Maize Corporation (NMC), in the past 40 years, Eswatini has never met the population's maize requirement (NMC, 2010). The MOA's Swaziland Market Assessment Report (2016) reveals that the country has averaged an annual cereal production of 92,000 tonnes since 2011 such that even in exceptionally good harvest years, Eswatini only produces enough to meet about 45% (110,250 tonnes) of its annual total cereal requirements of 245,000 tonnes. During the 2015/16 drought, maize production dropped by 67% forcing the country to import 30,446 tonnes of maize from South Africa. These production statistics indicate that the country is food insecure and, since the early 1990s, has shifted from being a net exporter of food to depending on food aid to feed its population (Tevera *et al.*, 2012).

On the other hand, the FAO and the WFP (2007) argue that HIV/AIDS is also a major contributing factor to the country's food insecurity at the household level. HIV and AIDS limits the ability of households to participate in agriculture for food production and income generation by increasing the number of people that need to be taken care of, and by taking the lives of traditional caregivers. Likewise, Waal and Whiteside, (2003) found that even though droughts and famines have afflicted a large part of Africa throughout history leading to food crisis, the HIV/AIDS epidemic in Southern Africa has its own contributing complexity on why many households face food shortages with hopeless trajectories of recovery. They attribute the impact of HIV on food insecurity at the household level to adult morbidity and mortality which contribute to a rise in the number of dependents; loss of assets and skills resulting from increased adult mortality; the burden of care being large for sick adults and children orphaned by AIDS; and to the vicious interactions that exist between malnutrition and HIV (Waal and Whiteside, 2003). Certainly, understanding the

determinants of food insecurity at the household and national level is a complex endeavour that cannot be attributed to one factor. There are synergies between a variety of factors and this study tries to identify the fundamental geographic and socioeconomic household conditions that make households vulnerable to food insecurity, particularly in the event of drought.

Droughts are a natural shock that heighten vulnerability to food insecurity because a majority of the population in Eswatini derive their livelihoods from rain-fed subsistence agriculture. Therefore, in the event of drought, crops and livestock can be diminished or wiped out to the point that little food becomes available to provide food for smallholders and their families. In other words, drought exposes the underlying household vulnerabilities to food insecurity, and for the 63% of population that lives under poverty in the country (Swaziland Income and Expenditure Survey, 2010), it means selling valuable household assets, changing to less preferred and less nutritious food, and turning to food aid to survive.

The country's National Development Strategy (NDS) and PRSAP recognise that Eswatini has a large rural population that suffers from inadequate access to food and high unemployment. The NDS expects the agriculture sector to implement strategies for food security enhancement, drought mitigation, poverty alleviation, and sustainable use of the Kingdom's natural resources. Empowered by the NDS, the Comprehensive Agriculture Sector Policy (CASP) (2005) acknowledges the fact that the deteriorating food security and poverty dynamics in the country can largely be explained by the poor performance of the agriculture sector. Therefore, it is important to make the appropriate household vulnerability interventions so that the agricultural sector can contribute fully to the development of the country.

Accordingly, Eswatini's Strategy for Sustainable Development and Inclusive Growth (SSDIG) stresses growth that will make significant investments in agriculture. Agriculture is uniquely positioned to reduce poverty and drive development in rural areas as most rural inhabitants depend on it for their livelihoods. Through the Swaziland National Investment Plan (SNAIP) (2014), the goal is to commercialise agriculture production and in the process create jobs. All these policies play an important directive to address the threats and opportunities in relation to food security in Eswatini. Hence, the National Food Security Policy (NFSP) (2005) forms the basis for priority setting and strategy development around food security which will be integrated into an overall Integrated Agriculture and Food Security Strategy and Action Plan. The NFSP

underscores the fact that recurrent droughts and the high incidence of HIV/AIDS in Eswatini are the major contributing factors towards adverse food insecurity. At present, a large proportion of the country's population face impacts of chronic drought conditions and impacts of HIV/AIDS leading to substantial declines in agricultural productivity. Findings of this study can inform policy decision on where to target agricultural investments and drought mitigation programmes focusing on the most vulnerable households.

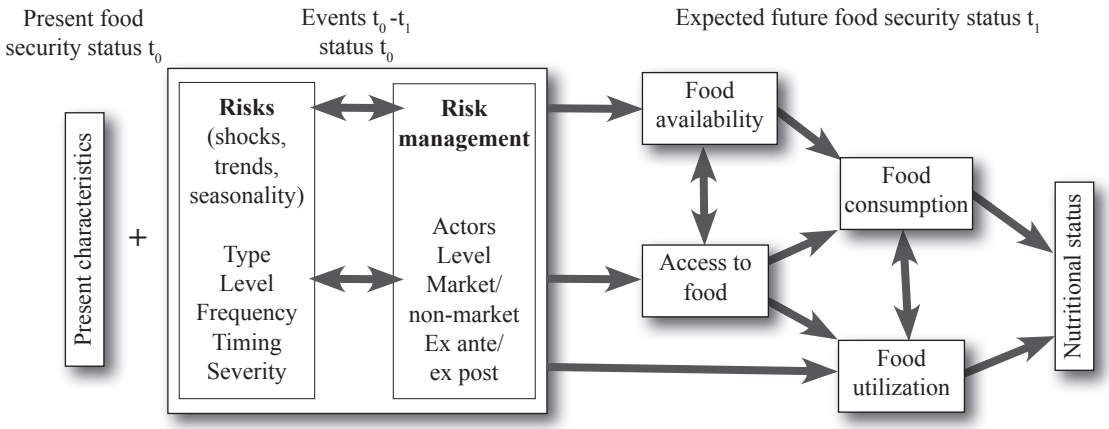
3. Methods

3.1. Conceptual Framework

A comparison of the socioeconomic and geographic factors of the households across the country exposes the underlying endemic vulnerabilities to food insecurity during droughts. Vulnerability describes exposure to risks, shocks, and stress and the difficulty in coping with these livelihood variables (Lawal, 2013). It can also be the factors that influence exposure to food insecurity and a household's predisposition to the consequences (Lawal, 2013). In terms of food insecurity, Lovendal and Knowles (2006) highlight that there are many factors that drive household food insecurity such as political, economic, environment, natural, social, infrastructural, and health issues, while Negatu (2006) emphasises the capability to produce one's own food and increase in purchasing power as the major drivers of food insecurity. Misselhorn (2005) identified five (5) general drivers of food insecurity: socio-political; scientific and technological; cultural and religious; physical, biological, and chemical; and demographic. Drivers were considered to either act over the short or long term (acute versus chronic drivers), and to act either directly, or indirectly by initiating other drivers of food insecurity. Generally, people experience food insecurity either because their access to food has been negatively affected, or because of a reduction in production of their own food resources (Misselhorn, 2005).

Lovendal and Knowles (2005) developed a vulnerability framework which states that current socioeconomic characteristics and exposure to risks determine household's future characteristics and their risk-management capacity. The vulnerability framework explains that at every point in time, households' current food security status is affected by their past status which in turn affects their future food security status as illustrated in Figure 1 below.

FIGURE 1: VULNERABILITY FRAMEWORK FOR FOOD INSECURITY



Source: Lovendal and Knowles, 2005.

Using this conceptual framework on the predictors of future food security status, modelling vulnerability can be grouped into two categories: (a) models that analyse vulnerability to stochastic events such as economic shocks and natural disasters; and (b) models that analyse vulnerability to the outcomes of those events (Capaldo *et al*., 2010). Therefore, an analysis of the vulnerability can provide estimations of the probability that a given household will lose access to food in near future as a result of an economic shock or natural hazard. The study uses this framework in identifying the predictors of food insecurity among households using the 2015/16 drought as a baseline predictor for food insecurity for future droughts. Of course, household's food insecurity status is dynamic and the future food insecurity status of a household will depend on the magnitude of future droughts and the ability of the household to shirk or manage that risk. Moreover, livelihoods can differ between households, depending on each household's capacity to earn income or engage in income generating activities. It also depends on the household's ability to secure ownership or access to resources and assets in order to shirk risks, ease shocks, and meet livelihood contingencies (VAC, 2014). Therefore, the impacts of droughts can vary significantly between constituencies and regions with Eswatini. The determining factors are the socioeconomic conditions of the households before such shocks hit. Given that in reality, each drought is unique, the capacity of households and the economy at large to mitigate and respond to its impacts varies according to the structures created by disaster risk management policy in a country (Donal and Svoboda, 2007).

Based on the above theoretical framework, the study proposes that the stated food insecurity status (SFIS) of a household during the 2015/16 drought in Eswatini can be explained in a two-dimensional space by geographic (G) and socioeconomic (SE) factors. Geographic factors include the four (4) regions of Eswatini divided into fifty-five (55) constituencies (Tinkhundla). Socioeconomic factors include household demographics (age and sex of household breadwinner), homestead structure, source of cooking energy, asset ownership, source of income and levels, livestock and crop production, household budget (money spent on food, health, education, clothing, and transportation), and impacts of the drought on food production and health. Other studies such as Nanseki (2015) use behavioural factors instead of geographic factors to examine the perceived food security status of a household.

3.2. Sample and Data Collection

In order to determine the predictors of food insecurity during drought at the household level, the study uses data obtained from the NDMA/SEPARC Socioeconomic Drought Assessment Survey conducted in November/December 2016. The socioeconomic impact survey uses a sample of 2,958 households clustered in 298 enumeration areas across the 55 constituencies (Tinkhundla) in Eswatini. The survey solicited responses from household breadwinners or an adult 18 years or older who is involved in decision making of the household. The survey questionnaire examines household demographics; asset ownership and risk to poverty; main sources of drinking water; main sources of income; household participation in agriculture; drought impacts and coping mechanisms; drought impact significance; household networks/social participation; drought mitigation measures; and drought response behaviours. An important variable used to assess food insecurity among the households is a binary response question which asks all households whether during the past 6 to 12 months of the drought they faced a shortage of food or money to buy food. The response from each household was either YES (coded: 1) the household faced a shortage of food or money to buy food, or NO (coded: 0) the household did not face shortage of food or money to buy food.

3.3. Analysis Framework

Studies that try to identify the determinants of household food insecurity either use a logit or probit model (Habyarimana, 2015; Mesfin, 2014; and François, 2010). Logit and probit models resemble a sigmoid function with a domain between 0 and 1. A logit model follows a logistic distribution whilst a probit

model follows a normal distribution (Green, 2000). The study models the stated food insecurity status of a household (*SFIS*) as a dichotomous/binary position: a household is either food insecure or food secure and nothing in between. The study selected the logit model because the qualitative response *SFIS* is a dummy (0) and (1) binary variable that is not normally distributed (Greene, 2000). Hence, the binary *SFIS* model assumes that the probability of being either food insecure (coded as 1) or not food insecure (coded as 0) is explained by the underlying geographic and socioeconomic characteristic of the households. Therefore, the logit regression model compares the means of the *G* and *SE* variables to the control group to determine if they are significantly different (Ravallion, 2001; Greene, 2000;). Variables that are significantly different are considered to have a predictive influence on the status of food insecurity in households in Eswatini. A logit model can be executed in Stata 14.0 Statistical Analysis Software as a logistic regression for ease of interpretation to give out the odds coefficient in terms of log of the odds, also known as the odds ratio. The odds ratio is the ratio of the probability that a household would be food insecure (Pi) to the probability of a household would not be food secure (1- Pi).

Before performing a logistic model, the study ranks the regions and the 55 constituencies in Eswatini according to overall impact of the drought on food security at the household level using a 5-point scale; 1: No Impact; 2: Minimum Impact; 3: Medium Impact; 4: High Impacts; 5; Severe Impact. On this 5-point scale, households were asked during the survey to indicate the overall impact of the 2015/16 drought on food security within their households. The higher the score (1-5), the more food insecure the household became due to the drought. The mean (average) score supports the predictors of food insecurity determined by the logistic regression in identifying the regions and constituencies in Eswatini that need priority in implementing food insecurity interventions.

TABLE 1: DESCRIPTION OF VARIABLES USED FOR THE LOGISTIC MODEL

Description of variables	Variable code	Remarks
Dependent		
Stated Food Insecurity Status (SFIS)	*Food_Insecurity*	
Independent (Geographic factors)		
Constituency	*Constituency_ Code*	Includes the 55 Constituencies of Eswatini
Region	*Region1*	Hhohho, Manzini, Shiselweni, and Lubombo
Urban/Rural	*Rural_Urban*	Rural: 1; Urban: 0
Independent (Socioeconomic factors)		
Sex of household breadwinner	*BW_Sex*	Male, Female
Age of household breadwinner	*BW_Age*	18-24; 25-34; 35-44; 45-54; 55-64; 65+
Education of household breadwinner	*Education1*	No Education; Primary; Secondary; High; Vocational; Non-Standard Curriculum; Diploma; Degree; Ph-D; Other
Cooking energy source	*cooking_source*	electricity; firewood; coal; paraffin; natural gas; solar
Homestead structure	*rooms*	1 room; 2-3 rooms; 4-5 rooms; >5 rooms
Toilet facility	*Toilet_type*	Septic tank; Pit Latrine; Community Toilet; No Facility; Other
Asset ownership	*car*	No =0; Yes=1
	hoe	No =0; Yes=1
	tractor	No =0; Yes=1
	water_tank	No =0; Yes=1
	electric_gas_stove	No =0; Yes=1
	no_assets	No =0; Yes=1
Livestock ownership	*cattle*	No =0; Yes=1
	chickens	No =0; Yes=1
	pigs	No =0; Yes=1
	goats	No =0; Yes=1
Crop production	*crop_farming_yn*	No =0; Yes=1
Source of drinking water when there is no drought	*NoDrought_ Drink_ watersource*	SWSC (Public Utility); Public Tap; Unprotected spring; Rain-water collection; Stream; River; Lake or Dam; Borehole; Other

Main source of income	*main_income*	Food crops agriculture; Cash crops agriculture; Raising & Selling livestock; Skilled/ professional worker; Trader; Construction; Transportation; Handicraft; Remittance; Mining; Pensioner; Salaried Employee; Private sector; Government employee; Other
Drought affected household main income		No, 0% reduction in income; Yes, reduced income by 75%; Yes, reduced income by 50%; Yes, reduced income by 25%
Monthly household budget	*Mealie_meal*	Money spent on maize meal
	Rice	Money spent on rice
	Vegetables	Money spent on vegetables
	Meat_Fish	Money spent on fish
	Pulses	Money spent on pulses
	Medicines	Money spent on medicines
	Education	Money spent on education
	Transportation	Money spent on transportation
	Monthly Savings	Money saved
Drought impacts	*Health_Decline*	Household experienced health decline due to drought
	Disabilities	Household affected by drought due to disabilities
	Reduced_ Agriculture_Water	Household experienced decline in water for agriculture
	Reduced_ Consumption_ Water	Household experienced decline in water for household consumption
	Exited_ Agriculture	Household did not participate in agriculture during drought

Source: Author's own representation using Survey Data

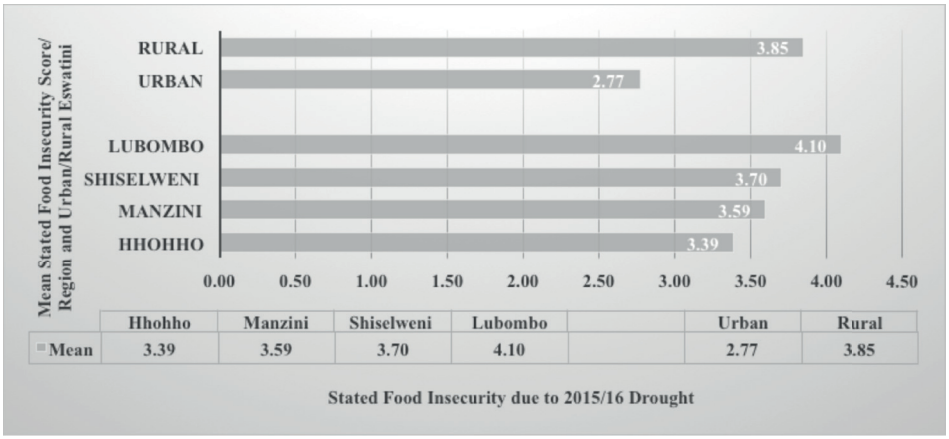
4. Results and Discussion

4.1. Household Stated Food Insecurity due to 2015/16 Drought Impacts

To determine the level of food insecurity within each household, the study also used the same 1-5 scale (1: No Impact; 2: Minimum Impact; 3: Medium Impact; 4: High Impacts; 5; Severe Impact). The mean score on this scale of household food insecurity stated by the households is 4.10 in Lubombo, 3.70 in Shiselweni, 3.59 in Manzini and 3.39 in the Hhohho regions illustrated in Figure

2. The data reveal that Lubombo households reported to be most food insecure followed by Shiselweni, Manzini, and lastly Hhohho. Within the regions, rural households reported a higher mean food insecurity score (3.85) compared to urban households (2.77) as shown again in Figure 2.

Figure 2: Household Mean Stated Food Insecurity Score



Source: Author's own representation using Survey Data

Most of the food insecurity impacts were skewed towards the severe impacts side of the food insecurity 5-point scale which suggests that the drought affected household food insecure substantially across the four regions of Eswatini. An estimated 51% of households in the Lubombo region stated experiencing severe impacts on food insecurity followed by Shiselweni (39%), Manzini (38%), and Hhohho (32%). In comparison, only 13% of households in Manzini, 12% in Hhohho, 8% in Shiselweni, and only 3% in the Lubombo region reported to have experienced no impacts in overall food insecurity impacts due to the drought. Constituencies that experienced the least impacts on food insecurity include Mbabane East, Mbangweni, Mahlanya, Pigg's Peak, Mbabane West, Lavumisa, LaMgabhi, Hhukwini, and Lobamba Figure 3 below. The Figure also shows other constituencies that experienced medium to high impacts on food insecurity. Constituencies that experienced the most severe impacts on overall food insecurity due to the 2015/16 drought include Lomahasha, Mthongwaneni, Matsanjeni North, Ngudzeni, Sigwe, Hlane, Madlangempisi, Sandleni, Mkhiweni, Sithobela, Ntontozi, Lubuli, Dvokodvweni, Mayiwane, Siphofaneni, Mafutseni, Ndzingeni, Mhlangatane, Matsanjeni South, Mahlangatja, and Nkwene as ranked in Figure 4.

FIGURE 3: HOUSEHOLD STATED FOOD INSECURITY SCORE (MINIMUM TO MEDIUM FOOD INSECURITY)

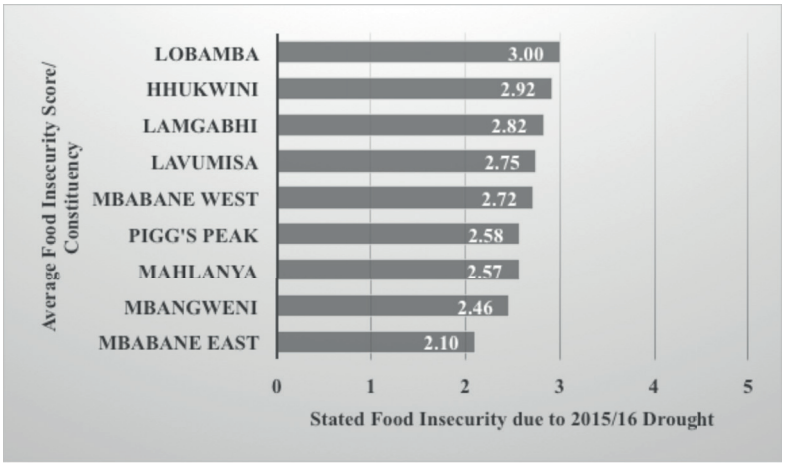
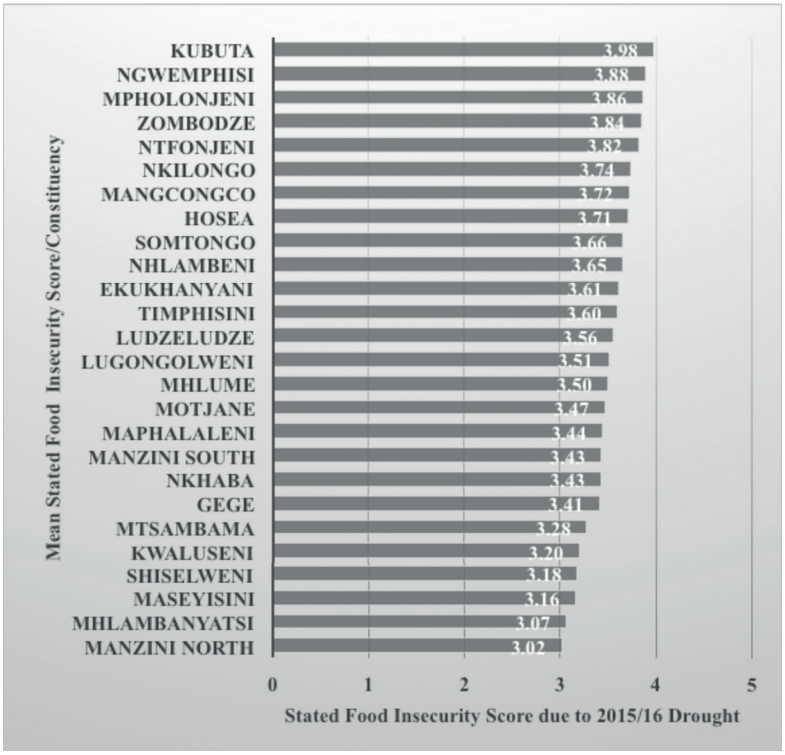
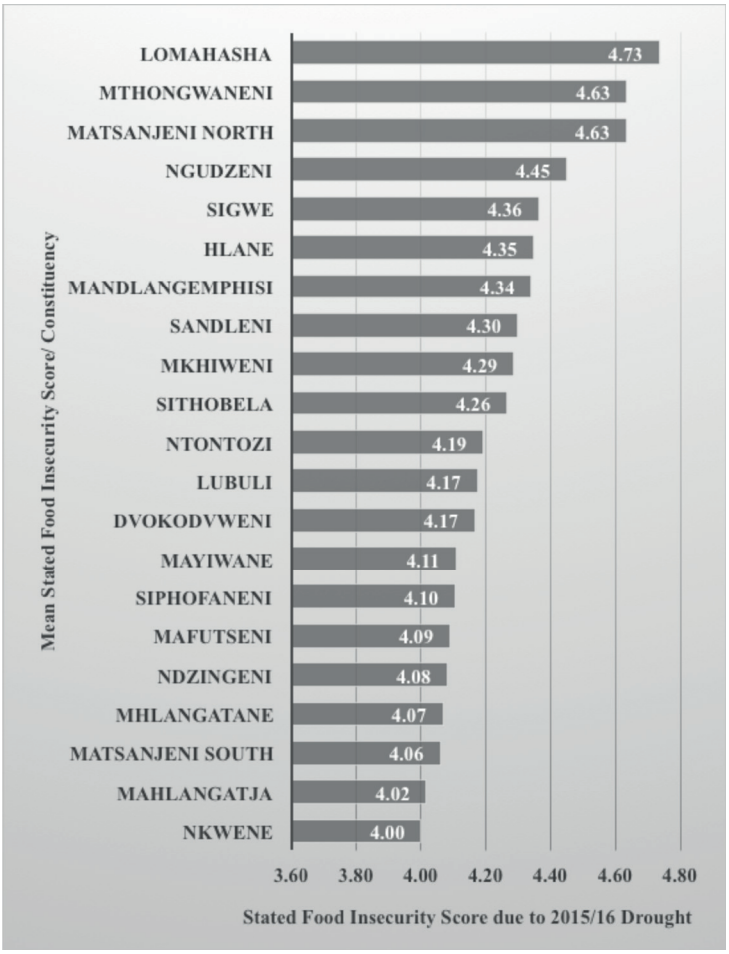


FIGURE 3: HOUSEHOLD STATED FOOD INSECURITY SCORE (MEDIUM TO HIGH FOOD INSECURITY)



Source: Author's own representation using Survey Data

Figure 4: Household Stated Food Insecurity Score (High to Severe Food Insecurity)

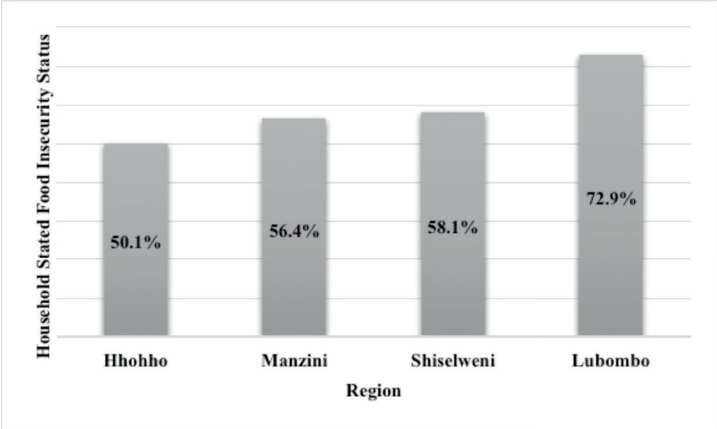


Source: Author's own representation using Survey Data

4.2. Logistic Model Results

The logistic model used in the study investigates the predictors of household food insecurity. Instead of the 5-point scale, the model uses a two level scale; 1: Food Insecure and 0: Not food insecure (food secure) Figure 5 below shows the mean SFIS score comparing the 4 regions of Eswatini. Lubombo reported 72.9% of households that were food insecure followed by Shiselweni (58.1%), Manzini (56.4%), and Hhohho at 50.1%. The percent of food insecure households were greater than the percent of food secure households in all four regions.

Figure 5: Regional Mean Stated Food Insecurity Score



Source: Author's own representation using Survey Data

The components of the SFIS model include geographic (regional factor) and socioeconomic factors that predict household level food insecurity in a drought situation. The log likelihood chi-square tests whether the whole logistic model is significant. The probability of chi-square is 0.0000 which indicates the model is significant as a whole. Using McFadden's pseudo r-squared (ρ2) to gauge the predictive strength of the model, the model gives a pseudo r-squared of 0.380. McFadden suggested ρ2 values of between 0.2 and 0.4 should be taken to represent a good fit of the model (Louviere *et al*., 2000), hence the SFIS logistic model of this study can be considered a good model.

Geographically, the odds of being food insecure are 1.67 times greater in the Lubombo region significant at the 1% (***) level or $p < 0.01$ when compared to the Hhohho region. Manzini region has a food insecurity odds ratio 1.3 times greater than Hhohho region but only significant at the 10% (*) level or $p < 0.1$. When the odds ratio is greater than 1, it describes a positive relationship, whilst an odds ratio less than 1 implies a negative relationship. Within each region, the larger the household's house, the less likely the household will experience drought induced food insecurity. Households that depend on oil lamps/lanterns for lighting are 1.7996** more likely to be food insecure during a similar drought than households that use electricity as their main lighting source and is significant at the 5% (**) level or $p < 0.05$. In contrast, the few households in the country that have installed solar panels for electricity to light their homes are less likely to be food insecure compared to those that use conventional grid electricity.

An analysis of the amenities/facilities in the home, the model reveals that households that depend on rainwater collection as their main source of drinking water are 3.1906*** times more likely to be food insecure than those who rely on the country's water utility company, the Swaziland Water Services Corporation (SWSC). Those that depend on boreholes are 1.6619** times more likely to be food insecure during a drought than those households that are connected to SWSC. Toilet facilities are also a good predictor of food insecurity within a household. Households that rely on their neighbours, and public toilet facilities compared to households that have septic sewer systems in their homes are 3.3930* times more likely to experience drought induced food insecurity.

Single room home structures also predict food insecurity as the model revealed that home structures above 2 rooms, the odds of being food insecure decrease by half (0.5275***). Wealthier households can afford to build larger houses, and so can typically afford to buy food as one of the basic necessities of a household even during shocks such as the 2015/16 drought. A surprising finding is that households that rent their homes are less likely to be food insecure by 0.4479*** odds compared to households that own their structures. This can be explained by the fact that renting in Eswatini is generally an urban phenomenon, and so urban households are richer than rural households, and rural households form the majority households in Eswatini.

In terms of asset ownership, the model indicates that ownership of cars (0.6553***), ploughs (0.5086*), water pumps (0.3193**), water tanks (0.7907*) are significant predictors of drought induced food security at the household level. Households that own these assets are less likely to be food insecure by the odds indicated in parenthesis. These agricultural production and water harvesting and storage equipment are expensive to buy. In contrast, households that own tractors (2.0693**) and hoes (1.3787**) are more likely to be food insecure. Similarly, the logistic model reveals that the odds of a household that depends on crop farming for food is one and half times (1.5567***) greater to be food insecure during a drought than the odds of a household that does not depend on crop farming to sustain its livelihood.

Comparing the levels of income regardless of income source, the model shows that all incomes above E1,000 increase a household's chances of being food secure significantly compared to households that do not have any form of income. The greatest impact in reducing food insecurity within a household is observed between the E3,001 and E4,001 level of income. This suggests that

households should at least earn an average of E3,500 to suitably shirk risk against extreme forms of food insecurity. Households whose incomes were not affected by the drought were indeed 36% less likely to be food insecure (0.3663***) than households whose incomes reduced by 75% as a result of the 2015/16 drought.

Food budgets also prove to be a good predictor of food insecurity among the sampled households. The results of the model show that households that spend more on mealie-meal and rice as a proportion of their total income are likely to be food insecure than those household that spend less on these items as a share of their total income. Maize is a staple food in Eswatini, therefore an increase in the price of maize and hence maize-meal increases the odds of a household being food insecure by 1.0017*** odds compared to households that spend less of their food budgets maize-meal. The results also suggest that rice is also increasingly becoming a staple food in the country. However, on the other hand, high spenders on vegetables, meat, and fish are less likely to be food insecure. Households that pay a premium on these food items (assuming premium quality of vegetables, meat, and fish) are less likely to be food insecure that those households that spend less of their food budgets on these items.

The ratio of money spent on transportation also predicts household food insecurity. Households that spend a lot on commuting costs are 1.0007*** times more likely to be food insecure than households that spend less of their total incomes on transportation costs. The regression suggests that transportation costs now so significant across the country such that they now have a huge bearing on the status of food insecurity among households. Wealthier households that do not feel the pinch on spending a significant portion of their total incomes are able to save, and as well, are less likely to be food insecure. Households that are able to save are almost 100% less likely to be food insecure (0.9996***) compared to households that are unable to save.

Finally, the logistic model demonstrates that high/severe health declines and severe impacts on disabilities associated with the drought contribute significantly to food insecurity within a household. Households that experienced high/severe impacts on health and disabilities as a result of the 2015/16 drought were 2.5 to 3 times more likely to be food insecure than household that did not experience deterioration in health or inconveniences from disabilities due to the drought. High to severe deterioration in health increases the household's odd to food insecurity by 2.55513*** to 2.9997*** while high and severe disabilities increase a household's food insecurity by 2.3966*** to 3.3119*** odds.

5. Conclusion and Recommendations

5.1. Conclusion

The study sought out to determine the geographic and socioeconomic factors that predict food insecurity among households in Eswatini. The study used a logistic regression model to determine the significance of these factors in predicting food insecurity among households in a drought situation using data collected during the 2015/16 drought. The study finds that most significant predictors of food insecurity, that is, factors associated with increased food insecurity odds at the household level include households in the Lubombo region because the region is the poorest among the four regions in the country and was worst affected by the drought in terms of overall food security. Households that do not have toilet facilities in their homesteads, households that depend on rainwater and boreholes as their main source of drinking water, and households that use lanterns or oil lamps as their main source of lighting are more likely to be food insecure. Other important factors associated with increased food insecurity at the household level include households that depend on crop production as one of the main sources of food, and can use the ownership of tractors and hoes within these households as a good predictor of food insecurity during a drought. The study also finds that the prices of maize and rice are predictors of food insecurity among households given that maize is a staple food in Eswatini. Finally, health decline and disabilities within a household were correlated with high incidence of food insecurity in a household. If the price becomes too high due to food inflation during a drought, many rural households become significantly vulnerable to food insecurity. Besides the factors associated with increased food insecurity, the study finds that households that spend more on vegetables, meat and fish were less likely to be food insecure. Vegetables, meat, and fish at a premium price can be considered luxury items in Eswatini. A major finding that cuts across all households in the country is that all incomes above E1,000 significantly reduce the chances of food insecurity among households with E3,500 being the optimal level of income for a household to shirk against extreme levels of food insecurity. Therefore, to contribute towards food security risk mapping for optimal distribution of food and drought mitigation programming the study finds that Lomahasha, Mthongwaneni, Matsanjeni North, Ngudzeni, Sigwe, Hlane, Madlangempisi, Sandleni, Mkhiweni, Sithobela, Ntontozi, Lubuli, Dvokodveni, Mayiwane, Siphofaneni, Mafutseni, Ndzingeni, Mhlangatane, Matsanjeni South, Mahlangatja, and Nkwene ranked as the top constituencies that suffered the worst impacts on food insecurity during the 2015/16 drought in the country.

5.2. Recommendations

Based on the findings, the study proposes the following set of recommendations:

- Deliberately target Lomahasha, Mthongwaneni, Matsanjeni North, Ngudzeni, Sigwe, Hlane, Madlangempisi, Sandleni, Mkhiweni, Sithobela, Ntontozi, Lubuli, Dvokodveni, Mayiwane, Siphofaneni, Mafutseni, Ndzingeni, Mhlangatane, Matsanjeni South, Mahlangatja, and Nkwene in implementing the programmes stipulated in the Food Security Policy (2005).
- In the event of drought, prioritise intervention programmes such as food distribution on households living with disabilities and those with deteriorated health status.
- Strengthen and expand the implementation of the Poverty Reduction Strategy and Action Plan to other regions through supporting the development of income generating activities among the poorest in Eswatini within these targeted constituencies.
- Focus the implementation of the PRSAP in the Lubombo region especially in investments in agriculture to increase the level of food production in this region.
- Encourage commercialisation and value-addition in rural households to increase national food production and incomes in households paying special attention to the Lubombo and Shiselweni regions.
- Investigate the suitability and sustainability of E3,500 minimum wage in Eswatini.

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Appendix:

Table 1: Logistic Regression Output

Food Insecurity Logistic Regression			Log likelihood = -1132.6361
	LR chi2(88) = 1371.75 Prob > chi2 = 0.0000 Pseudo R2 = 0.3772		
FOOD_INSECURITY	**Odds Ratio**	**Std. Err.**	**P>z**
Hhohho			
Manzini	1.3032	0.1930	0.074
Shiselweni	1.1695	0.1848	0.322
Lubombo	1.6709	0.3135	0.006***
BW_Sex			
Female	1.1503	0.1301	0.216
Rooms			
2-3 rooms	0.5275	0.0843	0.000***
4-5 rooms	0.4087	0.0871	0.000***
> 5 rooms	0.3121	0.1014	0.000***
House_ownership			
rent	0.4479	0.1254	0.004***
free rent/board	0.5757	0.1689	0.060*
other	0.2514	0.1865	0.063*
lighting_source			
lantern/ oil lamp	1.7996	0.4002	0.008***
candles	1.0539	0.1974	0.779
solar	0.0974	0.0974	0.020**
Toilet_type			
pit latrine	0.7994	0.1745	0.305
community toilet	1.4524	2.5134	0.829
no facility	0.7144	0.2858	0.401
other	3.3930	2.2726	0.068*
Household assets			
car	0.6553	0.1078	0.010***
refrigerator	0.8505	0.1415	0.330
tractor	2.0693	0.6029	0.013**
hoe	1.3787	0.2163	0.041**
plough	0.5086	0.0844	0.000***
water_tank	0.7907	0.1066	0.081*
wheelbarrow	1.1709	0.1549	0.233
water_pump	0.3193	0.1547	0.018**
no_assets	0.8582	0.4645	0.777
cattle	0.9906	0.0117	0.424
chickens	1.0089	0.0063	0.151
pigs	1.0021	0.0230	0.929
goats	0.9929	0.0104	0.495
Crop_farming_yn			
Yes	1.5567	0.2221	0.002***

NoDrought_Drink_watersource			
public tap	1.2168	0.2725	0.381
unprotected spring	1.2825	0.4233	0.451
protected spring	0.7594	0.2106	0.321
rain water collection	3.1906	0.9954	0.000***
water tanker/truck	1.9598	0.6999	0.060
stream	1.1940	0.4265	0.620
river	1.2817	0.3091	0.303
lake/dam	1.5162	0.6427	0.326
borehole	1.6619	0.4077	0.038**
other	1.9835	0.6340	0.032**
Main_income			
cash crops agriculture	0.7463	0.2990	0.465
raising & selling livestock	0.8020	0.3607	0.624
skilled/professional worker	0.9526	0.3341	0.890
trader	0.6811	0.2311	0.258
construction	0.8844	0.4627	0.814
transportation	2.4537	1.3953	0.114
handicraft	1.2065	0.4513	0.616
remittance	1.4073	0.4588	0.295
mining	2.2898	1.3868	0.171
pensioner	0.8679	0.2862	0.668
salaried employee private	1.0096	0.2941	0.974
other	1.0709	0.2864	0.798
Income_level			
less than E250	0.6615	0.2355	0.246
E250- E500	0.6971	0.2010	0.211
E501 - E1000	0.3999	0.0975	0.000***
E1001 - E2000	0.2551	0.0635	0.000***
E2001 - E3000	0.1682	0.0462	0.000***
E3001 - E4000	0.2554	0.0829	0.000***
E4001 - E5000	0.2948	0.1126	0.001***
E5001 - E6000	0.1115	0.0597	0.000***
E6001 - 7000	0.1294	0.0610	0.000***
Above E7001	0.1087	0.0372	0.000***
business	1.2866	0.2152	0.132
family	0.7950	0.1308	0.163
friends	2.2232	1.2462	0.154
Drought_affected_income			
Yes, reduced by 50%	0.9545	0.2520	0.860
Yes, reduced by 25%	0.7479	0.1933	0.261
No, 0% reduction	0.3663	0.0879	0.000***
Household food budget			
mealie_meal	1.0017	0.0004	0.000***
rice	1.0037	0.0010	0.000***
vegetables	0.9932	0.0010	0.000***
meat_fish	0.9976	0.0005	0.000***
pulses	1.0018	0.0013	0.162
medicines	0.9996	0.0008	0.605
clothing	0.9999	0.0001	0.499
education	1.0000	0.0000	0.313
transportation	1.0007	0.0002	0.000***
monthly_savings	0.9996	0.0001	0.007***

Health_Decline			
Minimal Impact	0.9287	0.1389	0.621
Medium Impact	1.1427	0.2370	0.520
High Impact	2.5513	0.6858	0.000***
Severe Impact	2.9997	0.9443	0.000***
Disabilities			
Minimal Impact	0.8643	0.1675	0.452
Medium Impact	1.0321	0.2124	0.878
High Impact	2.3966	0.6086	0.001***
Severe Impact	3.3119	1.0376	0.000***
_cons	6.4798	3.3716	0.000