

**Food Security and Conflict:  
Evidence from the Boko Haram Insurgency in Nigeria**

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## Abstract

This paper aims to study the impact of the Boko Haram Insurgency on Food Security in Nigeria. To aid this study, I employ data from the *General Household Survey (GHS)* conducted by the National Bureau of Statistics – Nigeria (NBS), as well as conflict data from the Armed Conflict Location & Event Data Program (ACLED). Using household per capita food expenditure as the proxy for food security, I adapt a food security index and estimate a probit model to determine the food security status of households. Results from the index highlight that Boko Haram activities affect the food security status of households; however, the difference between households in conflict-affected areas and non-conflict areas are not large as expected in terms of differences in the incidence, depth and severity of food insecurity. Using the probit model, I observe similar trends in the magnitude of Boko Haram’s impact on the food security status of households. But contrary to expectations, the results for 2012 indicate that households exposed to Boko Haram activities have a higher probability of attaining food security relative to households not exposed to conflict. In 2015, the case is reversed but the results are statistically insignificant; hence, I conduct additional tests using two different measures to improve the study.

*Keywords:* Food Security, Boko Haram insurgency, Probit model, Marginal effects

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## **1. Introduction**

Enhancing well-being around the globe today is a critical social target, due to the multiple roles it plays in achieving growth as well as development. Consequently, it has become imperative for each government to maintain the welfare of its nation. While there are several approaches to improving welfare, this paper focuses on the issue of food security. The subject matter is a unique developmental issue because, unlike others, it is not exclusively restricted to developing countries but is of concern to the world at large – albeit the former has food security as a crucial national objective in comparison to developed countries.

According to the World Health Organization (WHO), as of 2018, there were “821 million people now hungry and over 150 million children stunted, putting hunger eradication goal at risk” (WHO, 2018). Using the Food and Agriculture Organization (FAO)’s Prevalence of Undernourishment (PoU) indicator as one of the measures of food insecurity, we notice that the rate of the world’s population facing undernourishment has been on a steady decline – from 825.6 million in 2005 to 678.1 million in 2018. However, it was estimated that by 2019, there would be a change in this downward trend owing to factors like climate change and violent conflict. Reports suggest that 687.8 million people would be undernourished, and the trend would move upwards with an estimate of about 840 million people undernourished by 2030 (FAO, 2021). These reports were made pre-Covid19 and had not considered the impact of the pandemic on this trend. With the impact of the pandemic factored in, we can infer that there could be a larger increase in these figures than initially estimated, hence the relevance of this topic.

From these statistics, we observe that a larger proportion of these numbers are in Central and Southern Asia, but there has been a downward trend in the number of people facing undernourishment in these regions. The numbers have decreased from 574.7 million people in

2005 to about 385.3 million as of 2018. It is estimated that this decline will continue, such that by 2030, the population suffering from undernourishment would be 329.2 million. For Sub-Saharan Africa, the case has been the reverse, as there has been an increase in the number of people undernourished. The region experienced an increase in figures from 192.6 million in 2005 to 236.8 million by 2018. It was further predicted that by 2030, about 433.2 million of the population would be undernourished. All these estimates were pre-Covid 19 (FAO, 2021).

Nigeria, the most populous country in the Sub-Saharan region, is leading the trend and one of the major contributors to the ever-rising rate of people suffering from undernourishment. With a population estimated to be over 200 million as of 2018, it overtook India to become the nation with the highest number of people living in extreme poverty and this trend is estimated to remain fairly constant up until 2030 with a figure of 95.86 million (Roy and Divyanshi, 2019). This contrasts with the fact that Nigeria “holds the largest natural gas reserves on the continent and was the world’s fifth-largest exporter of liquefied natural gas (LNG) in 2018”. Although it was estimated that as of 2018, Nigeria had earned about half a billion dollars in revenue from this sector, the country has not experienced any significant improvement. The Nigerian economy is largely supported by revenue from the oil sector, with the non-oil sector contributing only 3.4% to the country’s GDP (Energy Information Administration, 2020).

This might be surprising, as the agricultural sector of the economy once contributed up to 62% of the country’s GDP as of 1960, but as this level of contribution decreased over time, the value of food imports in relation to total GDP increased from about 3% in 1960 to 25% by 2012 (Ahungwa, Haruna, and Muktar, 2014). With the population of the country rapidly increasing, the challenge of ensuring food security in the country intensifies. As of 2019, Nigeria ranked 94th out of 113 countries on the Global Food Security Index (GFSI); with a ranking of 79 in

terms of quality and safety, 90 for food affordability and 99 for food availability (GFSI, 2019).<sup>1</sup> Based on the Global Hunger Index (GHI) ranking, Nigeria is under serious threat from food insecurity. Although this is an improvement from the early 2000s when the country's score was 40.6 (the “alarming” range), down to 29.2 (the “serious” range), there is still cause for concern (GHI, 2020).

The causes of food insecurity are varied, ranging from subsistence farming practices,<sup>2</sup> lack of investment in the agricultural sector, poor infrastructure, climatic conditions and so on. In more recent times, conflict has become a major factor affecting the Nigerian economy, with activities like “insurgency (especially in the Northeast), armed banditry, communal,<sup>3</sup> pastoralist/farmer crisis, kidnapping and cattle rustling” to name a few (Ayinde et. al, 2020). Pertaining to the Boko Haram insurgency, it has reportedly led to the displacement of almost 2 million people in the Northeast region of the country, and in 2019 only, there were over 3,000 confirmed and reported deaths. With the Northern region being largely an agrarian region, this shock from conflict has worsened the already existing issue of food security in the country.

Considering the dynamic relationship that exists between food (in)security and conflict, the existing literature in this field is still growing. At the macro level, some authors find a negative relationship exists between food security and conflict [van Weezel (2018); Hitzhusen and Jeanty (2006); Martin-Shields and Stojetz (2018)], but they encourage and call for more research at the micro-level as the dynamics between food (in)security and conflict are context-

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<sup>1</sup> The Global Food Security Index examines food security across 113 countries (developing and developed) by assessing 34 different indicators with “an optional risk adjustment factor” – i.e., natural resources and resilience. These factors are indexed into three categories: affordability, availability and quality and safety. Then, the countries are ranked from 1 (being the best) to 113 (being the worst).

<sup>2</sup> Subsistence farming is the practice of self-sufficiency – growing crops for individual/household consumption such that little is left over from the harvest to sell for profit. Utilization of technology in farming processes is minimal/ moderate at best, but in most cases, non-existent.

<sup>3</sup> Communal clashes refer to violence between neighboring communities in the same local government area.

specific. They also acknowledge that an understanding of the role of different factors affecting food security at the macro-level can be masked when using macro-level variables instead of micro-level variables.

In Nigeria, there has been considerable growth in this field as more authors tackle these issues in a bid to develop efficient policies that can help the Nigerian situation. However, a number of existing studies are of a descriptive nature and this could be partly as a result of the difficulties associated with collecting the required data in conflict-affected areas. On the other hand, the existing literature in this field has considered several dimensions and with each, different metrics to determine the role of conflict in food insecurity in the country. This study contributes to the existing literature by assessing the impact of the Boko Haram insurgency on food security; specifically, how conflict affects the food accessibility dimension of food security. Using per capita food expenditure in the 2012 and 2015 post-planting seasons as a proxy for food security, I determine the incidence, depth and severity of food insecurity using a food security index; then, I estimate the food security status of households using a probit model.

The results from the food security index in 2012 correspond with the findings of authors such as Adepoju and Adejare (2013) and George et al. (2019); that conflict has a negative impact on food security, as I observe that households in areas affected by conflict have a higher food insecurity incidence relative to those in non-conflict affected areas. However, in 2015 this relationship does not hold, as households in conflict affected areas have a lower incidence of food insecurity relative to households in non-conflict affected areas. Using the probit model, the results highlight that in 2012, households in Boko Haram affected areas have a higher probability of being food secure than the reference group, by approximately 2.46 percentage points, which is contradictory to a priori expectations. In 2015, the results indicate that

households in Boko Haram affected areas have a lower probability of experiencing food security relative to the reference group by 0.22 percentage points; however, these results are statistically insignificant.

Additionally, I carry out further estimations to determine the impact of the Boko Haram conflict on food security in 2015, using two alternative measures as proxies for food security. The results from these estimations illustrate that households in conflict affected areas have a higher probability of experiencing food insecurity, by 20.65 percentage points when the measure of food security is based on a situation where the household did not have enough to feed all members. When the measure of food security is based on households reducing the number of meals, the results indicate that households in conflict affected areas have a probability of experiencing food insecurity that is about 31.25 percentage points higher than that of the reference group.

The rest of the paper is organized as follows: Section 2 provides a background to the study by highlighting the relationship between food security and providing some insight on the Boko Haram insurgency in Nigeria. Section 3 focuses on the existing literature in the field, beginning with broader food security and conflict studies, then narrowing the studies to existing literature on Nigeria. Section 4 presents the methods of estimation used in the study – the food security index and the probit model. Section 5 discusses the data sources in detail and provides some descriptive statistics. Section 6 presents the estimation results and then, I conclude in section 7 with the main findings and the conclusion.

## **2. Background to the Study**

This section provides some insight on *food security* and *conflict*, as well as context on the Boko Haram insurgency in Nigeria.

## **2.1 Food Security and Conflict**

The definition of food security has evolved over the years to reflect global concerns and development, but generally, it has come to be defined as “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO, 2006). Given this definition, food security is thus a multi-dimensional concept; however, it can be narrowed down to these concepts: availability, accessibility, adequacy, utilization and stability of food. Hence, when individuals are unable to meet one or more of these requirements, there is food insecurity.

The determining factors of food insecurity are varied, as they can be chronic, i.e., caused by persistent poverty, or transitory, with factors such as low rates of agricultural production as a result of subsistence agriculture, inadequate access to food supplies, weak infrastructure and low levels of public investment in agriculture and market systems, weak financial systems and extreme weather conditions to name a few (National Bureau of Statistics, 2017). While these factors are more common, a shock like conflict adds another dynamic to the issue of food security such that it hinders the efforts being made.

Just like food security, conflict has various definitions because it “is context-specific, multi-causal and multidimensional” (GSDRC, 2014, p.6). In this study, however, emphasis will be put on the issue of violent conflict, i.e., conflict involving “at least two parties using physical force to resolve competing claims or interests” (Frère and Wilen, 2015). Violent or armed conflict can be classified in various ways. For instance, it can be categorized based on the common goals or objective of the war – for example anti-regime wars, wars about autonomy and secession and decolonization wars. It can also be categorized by the political status or group of the actors involved. According to the Uppsala Conflict Data Program (n.d.), “an armed conflict is a contested incompatibility that concerns government and/or territory where the use

of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths in one calendar year.”

Regardless of the category of conflict, a combination of one or more of the following factors usually leads to conflict: political and institutional factors, cultural or religious factors, ethnicity factors, resource and environmental factors and socioeconomic factors. While each type of violent conflict is unique, some common factors they share are that they involve the use of force, clashes and displacement of people. Time-series data available from UCDP show that although the casualties are not up to the level of those recorded during the civil wars, there has been a large spike in the level of intra-state conflict in the world (conflict between state and non-state actors) in comparison to previous years (Cederman and Pengl, 2019).

## **2.2 The relationship between Food Security and Conflict**

The effects of conflict do not go unnoticed as the consequences are copious – for instance, according to one report, “of the 34 countries furthest from reaching the Millennium Development Goals (MDGs), 22 are in or just coming out of conflict” (Postnote 274, 2006). Conflicts are disruptive as they could potentially hinder growth in an economy and adversely affect the standard of living. For instance, conflict causes diversion of funds to cater for those injured, leaves individuals displaced, damages infrastructure, and disrupts the activities of those living in the area affected, to name a few.

It also creates an imbalance in the food market, as demand and supply are affected. Farmers are afraid and unable to go back to farming activities, and access to farmlands to transport food to other areas is restricted. This leads to reduced agricultural output and a decrease in labour productivity. Consequently, food availability is adversely affected as it is largely concerned with the supply side of food. With disruptions in the demand and supply cycle for food, food accessibility is affected, as there are physical and economic barriers to obtaining food. Given

a halt in business activities and destruction of infrastructure, people are unable to engage in income-generating activities and access to food markets is limited; thus, they are unable to afford food in terms of quantity, quality or both. This further disrupts efficient utilization of food is disrupted, as the supply chain of food and access to clean drinking water deteriorates – in the long run, this would lead to nutritional deficiencies and have negative impacts on the population and the economy. When at least one of these food dimensions is affected, it implies a lack of food stability, as this dimension is a combination of all the food security dimensions.

On the other hand, food insecurity can lead to various types of conflict. Although a behavioral factor and difficult to efficiently measure, food insecurity can lead to anti-social behavior that can disrupt the peace in a household or community – if left unchecked, this can escalate into full-fledged violent conflict. Newer studies are considering the fact that some individuals are put in situations such that they turn a blind eye or lend their support to armed groups in exchange for protection, and this encourages the growth of these groups. Other authors consider that low agricultural productivity and food price shocks can lead to violent conflict against the state or government and cite countries in Africa as an example (Martin-Shields and Stojetz, 2018).

In the long run, when these factors go unchecked or when there is no resolution in sight, it creates a food insecurity and conflict trap in the country. These issues further complicate studies in these field as issues of endogeneity arise as a result of reverse causality.

### **2.3 Brief History of the Boko Haram Insurgency in Nigeria**

Nigeria has a long history of conflicts arising from ethnic, religious, political and regional differences, but one of the most recent and ongoing conflicts is the Boko Haram insurgency. The Boko Haram sect was founded around 2002 in Borno state, located in Northeastern

Nigeria. It was an Islamist group with the aim of purifying Islam in northern Nigeria and bringing about regime change. However, following the death of their leader in 2009, there was an uprising leaving their followers, law enforcement officers and civilians dead. Subsequently, from late 2010, Nigeria began to experience an increase in attacks (through bombing, kidnapping, executions) that led to the declaration of a “State of Emergency” in the Northeastern states of Borno, Yobe, and Adamawa by 2013 (Dunn, 2018). This insurgency has been ongoing to date with various attacks every now and then.

Prior to the emergence of Boko Haram, the Nigerian economy had been riddled with food security challenges. This was largely as a result of government policies that were highly concentrated on the oil sector, alongside policies that were weak or unsustainable for the agricultural sector.<sup>4</sup> Lack of investment in the agricultural sector relegated farming and agricultural practices to the subsistence level, making it difficult to meet the ever-increasing levels of demand for food. This has made the country heavily import-dependent and in effect, more susceptible to food price volatility and the risk of food insecurity. While the intent or objectives of Boko Haram are not based on agricultural issues, there have been several consequences from their attacks on the country.

With the inclusion of violent conflict, reports show that the number of people suffering is on the increase. The Global Hunger Index shows that the proportion of undernourished in Nigeria went from 6.1 percent in 2009 (the year before the conflict) to 7.9 percent in 2014 (the year during the conflict) (GHI, 2020). Additionally, a study carried out by the FAO (2019), estimates that 1.9 million people have been internally displaced due to the on-going crisis, leaving 2.9 million people severely food insecure.

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<sup>4</sup> “Unsustainable” refers to the inability to follow through or complete each policy implemented. Once there is a change in government (a new regime begins), new policies are set to be implemented while previous policies scrapped, regardless of if they are effective or yet to reach their goal.

### **3. Literature Review**

In this section, some of the existing literature on *Food security* and *Conflict* is reviewed, starting from a global perspective then narrowing it to Nigeria. It concludes with the gap in related literature. Several authors have studied how violent conflicts affect food security and vice-versa by examining the role of food security and conflict traps across various regions or countries with similar or different characteristics. Some studies approach the subject at the macro-level, while some consider a micro-analysis. Generally, the consensus is that there is a negative relationship between the two, but the extent of the impact varies as each country has its own unique circumstance.

#### **3.1 Food Security and Conflict**

van Weezel (2018) carries out a cross-country analysis to determine the impact of armed conflict on food security at the macro-level. Using panel data from the FAO food balance sheets and armed conflict data from the Uppsala Conflict Data Program (UCPD), he studies a total of 106 countries in Africa, Asia, Central and South America for 50 years and utilizes dietary energy supply as an indicator of food security. Given the complex relationship existing between food security and conflict, an Error Correction Model is used to account for the issue of endogeneity given that in some cases, a bi-directional relationship exists between food security and conflict. The results show that generally, a negative correlation exists between food security and armed conflict. However, the impact on food security varies depending on the intensity and type of conflict – conflicts with higher intensity, for instance those based on a struggle for government power are shown to affect food security more than conflicts based on territorial issues. On the other hand, while food security in some countries was largely affected by the presence of conflict, others were not as affected.

Hitzhusen and Jeanty (2006) restrict their study to developing countries, as they aim to analyze the effect of conflict on food security – how conflict affects countries that are less food secure. Daily per capita calorie intake and the number of battle deaths per thousand of a warring population are used as proxies for measuring food security and conflict respectively. In addition to data from the FAO and UCPD, the authors also obtain additional country level data from the World Bank's Development Indicators. The study makes use of instrumental variables estimation techniques as well as fixed effects, generalized two stage least squares, and error component two-stage least squares estimation techniques to account for panel data being used. Using exclusion restrictions, they come up with five instruments that would be useful for the study: gross domestic product (GDP), urban population growth, ethnic fractionalization, agricultural growth and tropical location – these instruments also pass the test for validity. They use the Anderson canonical correlations likelihood-ratio test statistic, the Hansen-Sargan test of overidentification restrictions and a redundancy test to verify this validity. Regression results indicate the flaws that could exist when dealing with panel data in the presence of endogeneity, however; like van Weezel (2018), they observe similar results. Conflicts and wars have a negative impact on food security, but the effects are more harmful for developing countries that have lower calorie intake relative to the minimum dietary requirement. They also observe that regions that suffer from insecurity are regions that are densely populated.

Buhaug et al. (2015) analyze climate variability, food production shocks, and violent conflict in Sub-Saharan Africa. They use a country-level aggregate food production index, outbreak of conflict, general social unrest and inter-communal violence as the proxies for food security and conflict. The authors explain, however, that climatic conditions can affect both food security and conflict. Thus, they use country-specific indicators of temperature and precipitation to control for climatic variability. Data are collated from the FAO, UCPD and the National Oceanic and Atmospheric Administration. Their estimation techniques involve ordinary least

squares (OLS) regression, with country fixed effects and controls for time trends and serial correlation. The results indicate that a strong relationship exists between climatic conditions and food production but little evidence to support to the claim that climatic conditions have an impact on conflict. On the other hand, agricultural output and conflict are weakly related and underlying factors such as market failure, poor government policies, etc., could explain this result. However, they caution that these conclusions should not be taken in totality, as there are challenges that arise from panel data studies. They advise that more accurate results might be attainable from microdata as there are dynamics and events that are highly localized to certain locations.

Brück and d'Errico (2019) revisit the topic of food security and violent conflict using qualitative analysis to give an introduction as well as insight into the topic. At the macro-level, they observe a positive correlation between food insecurity and violent conflict, but note that it is difficult to fully understand the causal relationship as each country has unique experiences. Food insecurity and conflict traps might exist in various countries such that conflict leads to food insecurity and back to conflict, which makes the study complex. Additionally, they mention that it is not sufficient to consider only “active” conflicts, but fragile states and settings should also be considered as they have the potential to be affected. They suggest that in order to further identify causal relationships, micro-level data would be more appropriate as it allows one to handle the effects of heterogeneity that exist across different settings. Notably, they underline the effect resilience has on both food security and conflict, such that countries that have stronger mechanisms for coping with shocks are able to avoid protracted crises and vice-versa. To conclude, they acknowledge that there are existing gaps in the literature concerning individual country studies and encourage the use of micro-level data.

Verwimp et al. (2019) expatiate on the issue of micro-level studies by discussing the microeconomics of violent conflict. They explain that this field of development economics is relatively new, but could have significant impacts on results and help in explaining how different conflicts interact with other factors. They posit that using micro-level analysis allows one to determine the impact of conflict on households and communities, the role or contribution of individuals or groups of people to conflict either by free-will or by coercion and the effect of policies on those affected by violent conflict. They make a case for why micro-level conflict data should be preferred by clarifying some myths that exist about conflict. Two major cases reviewed include the following: it is possible to collate data in war zones as there are periods of break in every type of conflict and they also explain that economic activities still happen in spite of wars hence, the need to use micro-level data. While there are no surveillance systems in place to accurately monitor on-going violent conflicts, the authors call for the use of demographic and health surveys as well as behavioral experiments to obtain data. With the advancement of technology and data-collation methods, they believe that measuring and studying the dynamics at a micro level will greatly improve.

### **3.2 Food (In)Security and Conflict in Nigeria**

Focusing on Nigeria, a descriptive study was conducted by Attah (2012) on food security in Nigeria and the role of peasant farmers. He highlights the existing challenges faced by Nigeria in the agricultural sector that originated as a result of the discovery of oil. He notes that before emphasis was placed on the petroleum and oil industry, Nigeria's agricultural sector was generating the highest levels of employment and contributing the highest share of Gross Domestic Product (GDP). However, with dependency on the oil sector, the level of investment in the agricultural sector decreased and this resulted in low levels of productivity in the sector. This stemmed from the fact the oil sector was, and currently still is, the largest generator of foreign exchange for the economy. With higher rates of return on investments from this sector,

government budgetary allocations were thus allocated in favor of the oil sector. Consequently, farmers have to contend with lack of infrastructure necessary to promote farming practices. They are relegated to small-scale or subsistence farming practices and high levels of poverty, which hinder them from accessing credit to boost production.

Kah (2017) examines *Conflict and Food Insecurity in Nigeria and Cameroon* using a qualitative approach and sourcing data from World Bank, United Nations, Assessment Capacities Project reports and other scholarly papers, to name a few. The author notes that the Boko Haram insurgency has not affected only Nigeria; the cross-border incursions are also being felt in parts of Northern Cameroon. With the level of destruction in the region – loss of livelihoods, disrupted food supply and the like – access at borders is being restricted to contain the violence and prevent it from intensifying. The implication is that with restrictions on national borders, food supply from importation is even more difficult to access both directions; those that depend on Northern Nigeria for food supply, such as parts of Cameroon and Chad, and Nigeria that depends on food from imports. Thus, food insecurity worsens and increases reliance on international food aid.

Odozi and Oyelere (2019) take a broader prospective on the impact of conflict; they consider how conflict exposure has affected economic welfare in Nigeria. They do not restrict their assessment only to areas affected by the Boko Haram insurgency, but consider the nation as a whole given that at certain time periods, different parts of the country have been engaged in one type of conflict or the other. To determine the impact on the welfare of individuals, they utilize the fixed effects estimator for their panel data obtained from three waves of data (2010, 2012 and 2015) from the Nigeria General Household Survey (GHS) and conflict data from Armed Conflict Location and Event Data (ACLED) for the corresponding years. Their results indicate that regions of the country where poverty is highest, in terms of the gap and severity,

are regions that have been exposed to longer and more intense periods of conflict relative to other regions.

Bertoni et al. (2019) study the effect of Boko Haram on educational outcomes in North-eastern Nigeria from 2009 to 2016. Using within and between effects, they estimate the regression with the panel fixed effects technique. They also utilize the difference-in-difference estimation technique to compare before and after the conflict. To carry out this study, data from the General Household Survey (GHS) and conflict data from Armed Conflict Location and Event Data (ACLED) and Integrated Conflict Early Warning System (ICEWS) are used. The results provide evidence that there is a negative relationship between conflict and educational outcomes because there is a reduction in enrollment and dropout rates increase. The evidence also suggests that the quality of education provided decreases, students are more likely to dropout to assist their household in earning income and the health conditions of students decline.

Dunn (2018) focuses on a double difference estimation technique to determine the impact of the Boko Haram insurgency on childhood wasting in Northeastern Nigeria. While the study leans toward accessing health, it is also relevant to food security as the anthropometric measure she uses is one frequently used to study the adequacy of food (utilization), which represents one of the main dimensions of food security. Data for this study are from the Demographic and Health Surveys (DHS) on Nigeria, one from 2008 and the other from 2013. The results indicate that the Boko Haram insurgency has a negative effect on childhood wasting – the mean weight-for-height z-score and likelihood of wasting would have been significantly lower in the absence of conflict. The paper concludes that one probable reason for the result is the disruptive nature of conflict and the fact that the affected region was already underdeveloped relative to

other regions, although she notes that there could be other contributing factors that may have been excluded.

George et al. (2019) study armed conflicts and food security in Nigeria, focusing solely on the impact of Boko Haram's attacks. Using the General Household Survey (GHS) panel dataset for Nigeria, they assess dietary diversity and access to adequate quantity and quality of food during the 2010-2016 period. They classify conflict based on location of battles and those affected by conflict (civilians); then they address how it affects prices, farm inputs and income. They modify a utility maximization model of household food consumption which generates a food consumption score that measures food security, specifically food availability and access. Pooled OLS and fixed effects regressions, with additional controls, indicate that a negative relationship exists between conflict and food security; the higher the intensity of conflict, the lower the food consumption scores. In the short-term however, households are able to smooth their consumption by choosing foods with lower quality, by eating less or less preferred foods, amongst other factors, to prevent acute food insecurity.

Adepoju and Adejare (2013) construct a different food security index using mean per capita food expenditure to determine the food insecurity status of rural households in Nigeria. They use data from the first wave of the General Household Survey-Panel (2010-2011). Using household per capita food expenditure as their measure for food security and a probit model, they are able to classify insecurity status based on incidence, depth and severity across the different regions of the country. Results show that approximately half of the rural households in the country are suffering from food insecurity. The highest incidence of food insecurity is recorded in the Northern region of the country, with 56% of rural households in the North-East suffering from food insecurity. Regression analysis also shows that household characteristics and access to credit are determinants of food security during post-planting season.

Babatunde et al. (2007) investigate the socio-economics characteristics and food security status of farming households in Kwara State, North-Central Nigeria. For this study, the authors use a three-stage random sampling technique to obtain primary data for all variables in consideration from 94 farming households in Kwara State. Like Adepoju and Adejare (2013), they have a unique way of measuring food security. They construct a food security index based on the recommended daily caloric intake to determine the level of food security of households. Subsequently, they run a logistic regression and the results show that a larger percentage of households in Kwara state were food-insecure relative to those who were food-secure and fell short of the daily caloric intake by about 38%. They find that household income and the educational status of head of household were positive significant determinants of food security. The authors conclude that significant attention should be paid to household characteristics as they have the ability to influence the food security of households.

### **3.3 Gap and Contribution to Literature**

Several studies have been carried out to determine the impact of conflict on food security and vice-versa. Some studies identify a causal relationship between the two while some studies identify only a correlation. One thing they all have in common is that they emphasize the need for individual country analysis because of the heterogeneity that exists across various countries and types of conflict. Additionally, several studies highlight the fact that the relationship between food security and conflict is complex because of the possibility of food security and conflict traps existing, which would cause a reverse causality and affect analysis. Food security and conflict traps refer to situations whereby food insecurity causes conflict, then the conflict escalates and leads to worsening food security conditions than the onset. With intensified food insecurity issues, the intensity of conflict rises, and this creates an ongoing cycle of food insecurity and conflict.

This study intends to contribute to the literature by carrying out an empirical study on the impact of conflict on food security in Nigeria – more specifically; how the Boko Haram insurgency has affected the country, and this is relevant for several reasons. Firstly, this study adds to the existing literature on how conflict affects food security in Nigeria. Secondly, the problem of reverse causality due to a food insecurity and conflict trap does not exist. In the case of Nigeria, the conflict is not as a result of food insecurity; rather, it is driven by the activities of the Boko Haram sect whose aim is to purify Islam and rid the country of westernization. Studying the incidence of shock that conflict brings allows for one to truly understand the issue of food insecurity in Nigeria, as there were already challenges prior to the insurgency. It would give insight on how best to implement coping strategies and resilience post conflict.

#### **4. Model and Methodology**

Considering the multidimensional nature of food security, there are several metrics that can be used to measure food security across the various dimensions (food availability, accessibility, utilization and stability). Several authors have made a case for using micro-data for food security studies; thus, this motivates the approach used in this paper.

Ayinde et al. (2020) identify some of the methods that are applicable at the micro level, such as: Household Consumption and Expenditure Surveys (HCESs), Household Food Insecurity Access Scale (HFIAS), Coping Strategies Index (CSI), Household Dietary Diversity Score (HDDS) and Anthropometry. They explain that choosing a metric for a study is dependent on the target and purpose of the study. Given that this study analyzes food security alongside conflict, considerations have to be made for data availability. In lieu of these requirements, I find the Household Consumption and Expenditure Surveys (HCSEs) suitable for this study, as

it cuts across the food accessibility and food utilization dimensions and is useful for cross-country comparisons and subnational analyses.

The data from the surveys are analyzed in two parts; first, I utilize the food security index of Adepoju and Adejare (2013) for a descriptive analysis, then I use a probit model to determine the impact of Boko Haram activity on food security. Their food security index was constructed by adapting Foster, Greer and Thorbecke's (FGT) poverty index and is given as follows:

$$F_{\alpha} = \frac{1}{n} \sum_{i=1}^q \left( \frac{z - y_i}{z} \right)^{\alpha} \quad (1)$$

where  $F_{\alpha}$  is the food security index,  $z$  is the food security line (determined at two-thirds of the yearly mean per capita food expenditure),  $q$  measures the number of households below the line,  $n$  measures the total number of households in the sample,  $y_i$  is the yearly per capita food expenditure of the  $i$ th household and  $\alpha$  measures the sensitivity of the index with respect to food security, taking values of zero, one or two.

When  $\alpha$  is equal to zero, one obtains the index  $F_0$ , which measures the incidence of food security.  $F_0$  is equivalent to the headcount ratio. It measures the proportion of all households in the sample who are food-insecure, i.e., have yearly per capita food expenditures below the threshold. When  $\alpha$  is equal to one ( $F_1$ ), we obtain a measure of the depth of food insecurity amongst households. That is, for households below the security line, it measures the extent to which households are away from the line. Additionally, it also indicates the amount of transfers/monetary cost that would be required to bring these households out of food insecurity. When  $\alpha$  is equal to two ( $F_2$ ), the resulting index measures the severity of food insecurity amongst households. It accounts for the inequality that exists between the food insecurity status of households by assigning more weight to households with higher depths of food insecurity.

All three measures are beneficial, as they provide complementary information required to study the extent of food insecurity amongst households.

Although there are no strict rules on setting the food security line, two-thirds of mean per capita expenditure has found wider use in empirical studies when using the expenditure approach. It also allows for some level of variation among the food secure and insecure households compared to if food security levels are determined at half of the mean per capita expenditure. To suit this study, I use two-thirds of yearly mean household per capita food expenditure, as compared to the monthly mean per capita expenditure used by Adepoju and Adejare (2013), considering that I am focusing on post-planting periods.

The food security index effectively measures the food security status of households given that, it measures the incidence, depth and severity of food insecurity across various categories in the sample. However, when doing so, it does not hold the other factors constant. Using an econometric analysis enables one to effectively determine the relationship between the dependent and independent variables in terms of the impact the independent variables have on food security and how significant these determinants are. I employ a probit regression analysis to do so effectively.

The analysis of the probit model assumes that there exists a latent, unobserved continuous variable  $Y_i^*$ , that can be interpreted as an index of household food security. It can be described by the following linear equation:

$$Y_i^* = X_i'\beta + \varepsilon_i, \quad (2)$$

where  $X_i'$  is the vector of explanatory variables associated with food security,  $\beta$  is a vector of coefficients to be estimated and  $\varepsilon$  is a random error term that is assumed to have a standard

normal distribution. Instead of  $Y_i^*$ , we observe a binary random variable  $Y_i$  that reflects food security, such that:

$$Y_i = \begin{cases} 1, & \text{if food secure} \\ 0, & \text{if food insecure} \end{cases} \quad (3)$$

$$P_i = \text{pr}[Y_i = 1|X_i] = \Phi(X_i'\beta), \quad (4)$$

where  $\Phi(\bullet)$  is the cumulative distribution of a standard normal random variable.

The parameters of the model are estimated using maximum likelihood estimation and the full list of variables is discussed in the next section. Because the conflict variables are available only by state but the observations in the dataset are for households, the standard errors are corrected for clustering at the state level.

Because the probit model is nonlinear, its coefficients are not as straightforward to interpret as those of a linear regression model, so I compute the marginal effects of each explanatory variable. Considering that there are different ages, genders and educational status (to name a few), in the sample, there is no individual that would uniquely represent the entire sample; hence I use the average marginal effects approach compute the marginal effects.

## 5. Data and Descriptive Statistics

This section describes the data sources utilized and examines the trends in the data. The main sources of data for this study are the *2012-2013 General Household Survey (GHS) Wave 2* and the *2015-2016 General Household Survey (GHS) Wave 3*, which were conducted by the National Bureau of Statistics – Nigeria (NBS). The *GHS-Panel* is a component of the survey that collates data on welfare, economic and socio-economic characteristics at the individual, household, community and state levels. The survey is representative of the entire population as the sample size comprises 5000 households, randomly selected from the 6 geo-political zones, 36 states, 774 local government areas and rural or urban areas.

Data from the survey are acquired over two visits – the post-planting and the post-harvest seasons which range from September to November and February to April respectively. As the name implies, post-planting refers to the period after planting has occurred while post-harvest refers to the period after harvest. Given the nature of the study, data are extracted from only the post-planting seasons for both waves (2012 post-planting and 2015 post-planting); this enables more accurate results to be obtained. In post-harvest periods, food availability is higher relative to the post-planting periods given that produce from farms is readily available and is being supplied to the markets. Post-planting periods, on the other hand, mirror “normal” conditions, in the sense that food is not in excess supply; thus, it allows one to determine food security levels more accurately.

These two years are chosen for the study as 2012 is the year just before peak Boko-Haram activity, and 2015 is the year for which the next GHS survey is available. Given that the data collated at the GHS survey are available at different levels (individual, household, community and state levels) for different categories of the survey, I collapse the variables and merge them together for analysis; hence, all analysis is made at the household level. Notably, between the waves, there are missing observations due to the following: no response, households relocated and were unable to be tracked to the place of their relocation; some areas located in major conflict zones were inaccessible due to intense attacks related to Boko Haram activity. After removing missing or invalid records that are not essential to the analysis, the sample size for this analysis is 4,585 households in 2012 and 4,591 in 2015. Households were issued unique identification numbers in Wave 1, the first GHS survey carried out and in subsequent surveys, these households retain their unique identification numbers, which enables comparison across different waves.

## 5.1 Dependent Variable

The dependent variable in this empirical study is *Food Security*. As discussed earlier in the paper, the issue of food security is complex; hence, the focus of this study is limited to the accessibility dimension of food security, which is concerned with physical and economic access to food.

To carry out this study, food security is measured in several ways. Per capita food expenditure is used as a proxy to capture the food security status in the country. This comprises total food expenditure for the post-planting year (i.e., all food expenditure from the last post-planting period to the current period), adjusted for the household size of each household in the survey.<sup>5</sup> Subsequently, I create a 0-1 dummy variable to classify households into two groups, such that they are either food insecure or food secure respectively. The food security status of households is determined such that, if a household's yearly per capita food expenditure falls below two-thirds of the yearly average per capita food expenditure of all households in the survey, they are food insecure.<sup>6</sup> On the other hand, if the household's per capita food expenditure is equal to, or above the two-thirds measure, the household is deemed food secure.

I use a probit model to estimate the impact of the household characteristics, socioeconomic characteristics and conflict on household food security. In addition, the GHS survey asks specific questions related to food security experiences based on a 7-day recall approach. Some of the questions include “*How many days had to: rely on less preferred foods, limit variety of foods eaten, limit portion size at mealtimes*”, etc. I choose two out of the list of questions and adjust the model for conflict 7 days prior to the survey and re-estimate the probit model to further examine food security. Using these questions, I create a 0-1 dummy variable such that,

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<sup>5</sup> Per capita food expenditure is obtained by dividing each household's total food expenditure by the total number of individuals that live in the household.

<sup>6</sup> Two-thirds is used as a measure as it is a popular approach that has been used in previous empirical studies [Bamou and Mkouonga, (2008); Omonona and Agoi, (2007)].

if a household has not reduced the number of meals or faced a situation where they did not have enough to feed the household, it has a value of 0, otherwise one. Thus, the binary outcomes for these estimations differ from the previous estimations. The dependent variable takes a value of 0 for food secure households and a value of 1 for food insecure households.

## **5.2. Independent variables/Covariates**

### **5.2.1 Conflict**

Data for *Conflict* in Nigeria is obtained from Armed Conflict Location & Event Data Program (ACLED). Considering that this study aims to examine the role of Boko Haram activity on food insecurity, the data used will be restricted to only incidents related to Boko Haram activity. The dataset identifies dates, locations, main actors, associated actors, event type and fatalities of all conflict events in the country. Therefore, to estimate the econometric model, I use a dummy variable to determine the absence and the presence of Boko Haram activity with values of 0 and 1 respectively. An event is classified as Boko Haram activity if either the main actor or associated actor is listed as the Boko Haram sect. I also construct a variable to measure the number of total fatalities per state.

To determine the timeframe of conflict events that will be utilized for the study, I follow a similar approach to that used by George et. al (2019). The interviews for the GHS panel in the post-planting period start around the last week of September or the first week of October, thus, I use October 1<sup>st</sup> as the benchmark for collating data. If a household was interviewed in September/ October 2012, the corresponding conflict data will include all events that occurred from October 1<sup>st</sup>, 2011 to September 30<sup>th</sup>, 2012. For wave 3, I repeat this process but adjust the dates such that it includes events that occurred from October 1<sup>st</sup>, 2014 to September 30<sup>th</sup>, 2015. For the additional model, I estimate, I adjust conflict events such that they begin on 23<sup>rd</sup> September 2015 and end on the 30<sup>th</sup> of September 2015.

The ACLED dataset collates information at the state level; hence, to use the data at the household level, I use the following steps. First, I assign values of 0 and 1 to determine Boko Haram activity for all events during the specified periods, then I collapse the data at the state level to determine the total number of fatalities per state. To ensure it captures Boko Haram activity at this level, I assign values of 1 if at least one incident of conflict in the state was related to Boko Haram activity and 0 otherwise. The a priori expectation is that regions exposed to Boko Haram activity would be vulnerable to food insecurity and regions with higher fatality rates/average fatality rates would be more vulnerable to food insecurity.<sup>7</sup>

### **5.2.2 Other Determinants of Food Security**

To account for the differences amongst the different households in the survey, I include various characteristics that are considered important and can impact food security levels at the household level. They can be classified into two groups: socio-demographic characteristics (age, gender, occupation, educational status, marital status of the head of household, dependency ratio, household size) and socioeconomic characteristics (household expenditure, food prices and access to credit).

Regarding the age of the head of household, the impact it has on food security is not certain. The a priori expectation is that the coefficient estimates should be positive, given that wealth accumulates over time theoretically. Consequently, with more wealth accumulated over time, the older the head of household, the more food secure relative to younger households. However, the results of Babatunde et al. (2007) indicate a reverse case; households in which the head of the house is older tend to be more vulnerable and are prone to a higher risk of food security relative to households with younger heads of household. Arene and Anyaeji (2010), on the

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<sup>7</sup> Average fatality rates are calculated by dividing the total number of fatalities in each state by the number of households in the specific state.

other hand, observe that households in which the head of the house is older are more food secure relative to households with a younger head of house.

The gender of the head of household is included as a factor that contributes largely to the food security status of households, but as with age, there is no consensus on the role of gender in determining the food security status of the households. According to Ibukun and Adebayo (2021), some authors find that male-led households face a lower risk of food insecurity than female-led households. However, contrary to this result, they note that the role of gender in determining food security is insignificant.

The marital status of heads of households is important because households in which respondents are single (not married) are expected to be at less risk of food insecurity relative to those with a married head of household. The assumption is that a household in which the head of the house is not married would have a lower dependency ratio and smaller household sizes.<sup>8</sup> Considering that the educational status of the heads of households is not provided for all respondents, I use the highest educational status completed in each household. The expectation is that with higher educational attainment, individuals in the household have access to higher wages/salaries and can engage in non-agricultural income-generating activities. Furthermore, the households would have increased welfare, and thus be more food secure.

Food prices in different regions can affect the food security status of households; regions with higher food prices are expected to experience a higher risk of food insecurity relative to lower-priced regions. I choose three staples from the Nigerian food basket (rice, beans and garri) to study this effect.<sup>9</sup> To observe per capita expenditure on non-food items, I use data on total household expenditure on non-food items over a 12 month (i.e., all non-food expenditure –

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<sup>8</sup> Dependency ratio is calculated as:  
(Number of people contributing to the household spending/Household size) x 100

<sup>9</sup> Garri – also known as Cassava flakes

frequent and non-frequent, from the last post-planting period to the current period), adjusted for the size of each household. According to the International Food Policy Research Institute (IFPRI), households that spend a larger proportion of their income on purchasing food relative to non-food items are more vulnerable (Smith and Subandoro, 2007). Therefore, we expect a positive relationship between food security and expenditure on non-food items.

As for credit, the expectation is that households that have access to credit from financial institutions would be less vulnerable than households who have access to only informal sources of credit. Finally, I include temperature and rainfall as measures for weather conditions as factors that can influence food security and these variables are household specific.

### **5.3 Descriptive Statistics**

Table 1 in the appendix presents the frequency distributions of respondents at the geo-political levels in 2012 and 2015. The distribution of total respondents in the sample remains fairly similar over the years. Noticeably, there is a decrease in the number of respondents from the North-East zone; the distribution goes from 721 respondents in 2012, to 634 in 2015. This can be attributed to Boko Haram activities – the GHS survey also highlights that due to insurgency in some areas, households in previous waves were unable to be tracked. Table 2 indicates that distribution by sector (rural and urban) remains relatively constant from 2012 to 2015, with a value of 32% from urban areas and rural areas with 69% and 68%.

Table 3 highlights the gender ratio of the head of the household, and I observe that for both years, the percentage of male respondents are about 8 times higher than the female respondents. The proportion of head of households married in both years, are significantly higher than those unmarried as shown in table 4 – with a value of 79.8% in 2012 and 75.21% in 2015. Table 5 illustrates that a larger part of the sample – at least 60% in both years – is engaged in agricultural activities relative to non-agricultural activities. Regarding the educational status of

the household in table 6, the frequency distribution indicates that the highest level attained by majority of the sample is secondary school education.<sup>10</sup> In 2012, 47.85% of the population had completed secondary school, in contrast to 7.9% that completed a bachelor's degree program. This percentage remains relatively the same in 2015.

The frequency distribution in table 7 implies that the proportion of middle-aged respondents (ages 38 to 57) makes up the larger part of the sample with a percentage score of 46% and 48% for the respective years. According to table 8, respondents without a bank account make up a larger portion of the sample. In 2012, 68.26% report that they have no bank account, while only 32% have an account; by 2015, the percentage of respondents with a bank account increases to about 38%. Table 9 highlights the proportion of respondents who have attempted to borrow credit from friends, formal or informal sources and have been denied. The results indicate that more requests are granted than denied – in 2012 for instance, only 14.54% were denied access to credit while 85.46% reported they had never been denied access.

The food security status of the country, disaggregated by zones, is displayed in table 10. Notably, the level of food insecurity is high, and this coincides with statistical reports that indicate Nigeria has high levels of food insecurity. While there is an improvement from the 1,155 households that are food secure in 2012, to 1,325 in 2015, over 3,000 households are classified as food insecure. For both years, the results also indicate that the households in the North are more vulnerable than households in the South. In 2012, the majority of households that are food insecure are from the North-west regions, while South-west yields the lowest number of food insecure households. Regarding the number of fatalities, 2015 records a higher number of deaths within a state, relative to 2012. In 2012, the highest number of fatalities from

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<sup>10</sup> Secondary school education is equivalent to High school education.

one state was 463 people, while 2015 records deaths up to 7609. Summary statistics for all variables are found in table 11.

## 6. Results

### 6.1 Food Security Index Results

Utilizing the food security index of equation (1) that measures the incidence, depth and severity of food insecurity, I calculate the food security status of all households in the sample; then, I re-calculate for selected socio-demographic categories considered in the study. The results for the three versions of this index are presented in table 11 of the appendix. Recall that the food security line for the post-planting period is defined to be two-thirds of the mean yearly per capita food expenditure of households in the sample. Households that have yearly per capita food expenditures that are equal to or above the mean per capita food expenditures are deemed food secure – otherwise, they are considered insecure.

In the 2012 post-planting season, the food security line is calculated to be approximately ₦17,539.91 for all households.<sup>11</sup> At this benchmark, the incidence of food insecurity (F0), which is equivalent to the headcount ratio of food security in the country, is 0.74.<sup>12</sup> The implication is that 74% of households in the country are food insecure, while 26% are food secure. Since the depth of food insecurity (F1) is 0.47, it means that, on average, ₦8,243.76 in transfers will be required to bring each household out of food insecurity; in essence, about ₦36,676,478.01, if utilized efficiently, will be required in total to bring all households below the food security line out of insecurity.<sup>13</sup> Because it squares the relative gap between household per capita food expenditure and the food security line, the severity measure of food security

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<sup>11</sup> 1 USD = 381.508 Nigerian Naira, 45.97USD = ₦17,539.91

<sup>12</sup> Headcount ratio: this refers to the proportion of households in the sample living below the food security threshold/line. It is the number of households below the line / total number of households.

<sup>13</sup> To calculate the transfers required: (depth of food insecurity/100) x food security line

places a greater weight on households with a high level of food insecurity. It accounts for inequality that exists between the households that are below the food security threshold, given that some households are more food-insecure than others. Using this approach, the severity of food insecurity (F2) is given as 0.30 for Nigeria as a whole in 2012.

In the 2015 post-planting season, the levels of food insecurity are quite similar to the results obtained in the 2012 season. The threshold for measuring food security is given as ₦20,357.12; according to this measure, 0.71 households are food insecure. Although this is a decrease in the percentage from 2012, the trend of insecurity still remains – the majority of households in the country are food insecure. These results tally with statistical reports from the World Food Programme (WFP, 2021) that indicate that Nigeria is suffering from hunger and food insecurity. The depth of insecurity also sees a one percentage point decrease from the previous period. With a depth of 0.46, it is estimated that on average, a household would need ₦9,364.28 in transfers in get to the food security line and in total, a sum of ₦42,991,387.44. The severity of food insecurity remains the same between both periods.

Disaggregating by zones, I observe that households in the Northern region of the country have higher incidences, depth and severity of food insecurity relative to those in the South. With an incidence level of 0.87 in 2012, the households in the North West are the most food insecure region in the country, however, by 2015, this value increases to 0.90. This feat contrast reports which indicate that households living in the North East are the most vulnerable (WFP, 2021); from the results, one can observe that the North Eastern zone closely follows the North Western zone with a value of 0.83 in 2012 and 0.86 in 2015. One plausible explanation is that households from the North East are not widely presented in comparison to the North West as the NBS notes that, some areas in the North East became inaccessible due to conflict (NBS, 2015).

I also observe that the zone with the lowest level of insecurity is the South West zone of the country. The incidence of food security is given as 0.56 in 2012 and 0.57 in 2015. Households in the South East and South-South experience significant drops in the incidence of food insecurity – South East drops from 0.69 to 0.59, while South-South drops from 0.68 to 0.56.

Regarding the gender of the head of household, the results from the 2012 period highlight that male-headed households are more likely to suffer from food insecurity than female-led households. For men, the incidence of food insecurity is 0.79, which is 0.19 times higher than the incidence level for women. Although there is a decline in the incidence of insecurity by 2015, the pattern still remains. Interestingly, in terms of age, the trend is such that the youngest cohorts (i.e., youngest head of households) experience the least amount of food insecurity. Subsequently, the incidence of insecurity increases and is highest amongst the middle-aged respondents and this violates economic theory of wealth accumulation. For age groups 68 and above, they follow behind the youngest cohort with an incidence level of 0.63. This could be due to smaller household sizes if we consider that their children/wards may have moved out of the household or the fact that they may receive remittances alongside their own income which would increase expenditure.

Notably, the difference between households residing in areas experiencing Boko Haram activity is not as large as expected. Amongst households that do not experience any Boko Haram activity, 72% of them are food insecure; among households that experience Boko Haram activity, the incidence of insecurity is 76%. This could indicate that the shock brought on by Boko Haram activities is not as large as expected and the challenge of food insecurity in the country goes beyond the insurgency. Surprisingly, the incidence of insecurity for households reporting Boko Haram activity declines in 2015 to 70%. Various factors could be responsible for this trend – two plausible factors are missing records from inaccessible

households or higher food prices. Bearing in mind that the supply chain for food has been disrupted, food prices in conflict affected areas are expected to be higher than non-conflict zones and higher prices could imply higher expenditure for households that are able to afford it. Since the FGT index captures only food expenditures, this could explain why these households are spending more (i.e., having higher per capita expenditures) than household in non-conflict zones.

## **6.2 Probit Estimation Results**

To aid this analysis, the reference group for this study is a female respondent aged 27 or below, living in rural areas located in the North Central region.<sup>14</sup> The highest level of education in the household is below secondary school, the household is employed in the agricultural sector and the household does not report any Boko Haram activity. In terms of finance, no individual in the household has a bank, informal or cooperative account and they have not borrowed from friends, informal or financial sector. The list of variables and variable descriptions are found in table 12 of the appendix, while summary statistics for the variables can be found in table 13.

The results for 2012 are reported in table 14 of the appendix. According to the results of the marginal effects reported in column 4, respondents who live in areas that record Boko Haram activity have a higher probability of being food secure than the reference group, by 2.46 percentage points. While these results differ from the food security index, we can still infer a similar pattern; the impact of conflict on food insecurity is small relative to the effects of numerous other factors. As stated earlier, one plausible explanation for this result may be inflated food prices. Considering that conflict disrupts the demand and supply cycle of food, households in conflict affected areas are faced with scarcity and higher food prices. Assuming the types of food items purchased by households across the country are similar, households

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<sup>14</sup> A reference group refers to the base group which is used to make comparisons between the different groups in a study.

living in conflict affected areas will have per capita food expenditures that are higher than households in non-conflict areas.

The results also show that the higher the number of fatalities reported, the higher the probability of being food-secure by 0.012 percentage points – however, these results are not statistically significant. Using the adjusted measure of average fatalities per number of households in each state, I observe that an increase in the number of average fatalities decreases the probability that a respondent is food secure by 1.87 percentage points; nevertheless, the result is again not significant.

A respondent living in an urban area has a higher probability of attaining food security relative to respondents living in rural areas by approximately 4.1 percentage points. If we compare two households who differ only in that one has a head of household who is married and one not married, the married household has a lower probability of attaining food security given that the marginal effect is approximately 4.5 percentage points. This can be explained by a larger household size and the dependency ratio.<sup>15</sup> Married households are more likely to have larger households relative to unmarried households and consequently, the dependency ratio is smaller. This corresponds with the results for the variables that measure dependency ratio and household size. Both results are statistically significant and show that a larger household size will reduce the probability of food security by 4.2 percentage points, while a larger dependency ratio will increase the probability of food security by 0.174 percentage points.

For male respondents, the result highlights that they have a lower probability of being food secure, relative to the reference group. This result is suggestive at best, because it is not statistically significant, and this coincides with the findings of Ibukun and Adebayo (2021).

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<sup>15</sup> dependency ratio = number of household members actively engaged in labour activity/household size

Notably, the results indicate that respondents living in the Southern regions of the country, have a lower probability of being food secure relative to respondents in the North Central region. The marginal effects are -0.052, -0.049 and -0.014 for the South East, South-South and South West respectively. Of these results, only the reported result for the South East zone is statistically significant, implying a reduction in food security of 5.2 percentage points. One factor that could account for this trend is a reduction in food supply from the North. Nigeria has a diverse ecological system, and the implication is that specific crops are only grown in certain parts of the country. The Northern region is known for growing cereal crops and one such crop is rice – a staple food of all households in the country (Adesimi and Aderinola, 1983). Therefore, it follows that a reduction in food accessibility between the north and south could lead to food insecurity.

In terms of education, if we compare two households who differ only in that the highest level of education is a bachelor's degree, the probability of being food secure is higher by approximately 2 percentage points for the household with a bachelor's degree; the results, however, are statistically insignificant. With respect to age, I find that the older the respondent, the lower the probability that their households would be food secure, relative to the reference group. Households who are employed in non-agricultural sectors have a higher probability of being food secure relative to the reference group by approximately 3 percentage points and this is in line with a priori expectations. Based on finances, households that have bank accounts have a higher probability of 0.05039 of being food secure relative to households with no bank account. Although the results for borrowing are insignificant, the results match a priori expectations that households that borrow have a lower probability of attaining food security.

In line with the IFPRI's observation (Smith and Subandoro, 2007), the higher the per capita non-food expenditure of households, the higher the probability of being food secure.

Nonetheless, I observe that the magnitude of the effect is minimal as it only affects the food security status by 0.001 percentage points. Concerning food prices, garri prices contradict the a priori expectation that higher food prices will result in food insecurity. Instead, results show that as garri prices increase, a household has a higher probability of being food secure by 0.004 percentage points. This is likely as a result of garri being a Giffen good; therefore, as the price of garri increases, the quantity demanded increases and this means, higher expenditure. Recalling that our measurement of food security is based on food expenditures, this would explain why households that consume more garri are labeled food secure.

Consistent with the findings of the food security index, on average, the predicted probability that a household will be food secure is 21.5 percentage points which indicates that the proportion of households that are insecure is greater than those secure. Generally, the model has some explanatory as the results indicate a pseudo R-squared value of 0.50 and at the 1% level of significance, the Chi-square values for a test that all the slope of coefficients are zero is statistically significant. In terms of predicted probabilities, the model classifies 90.05% of the outcomes correctly.

In the 2015 model, after running a VIF test for multicollinearity, I drop the following variables from the model due to collinearity: average fatalities per household in a state and borrowing from friends, informal and financial sectors.<sup>16</sup> The results from the probit regression are found on table 15, column 4 of the appendix. This time, I observe different results for the impact of Boko Haram activity on the food security status of households. Although not significant, the results indicate that households in areas that record Boko Haram activity have a lower probability of being food secure by 0.215 percentage points. Additionally, I observe that the more fatalities recorded, the lower the probability of households being food-secure – however, like Boko Haram activity, these results are not statistically significant.

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<sup>16</sup> VIF results are reported in the notes under each regression table.

One plausible explanation for this could be due to a unique issue of reverse causality between food security and conflict. While Boko Haram activities disrupt farming activities and lead to food insecurity, food insecurity leads to increased conflict, but in this case, the Fulani Herdsmen conflict. The Fulani Herdsmen conflict is another type of violent conflict that has gained attention in Nigeria in recent times, given the number of casualties it has accrued over the years. The original foundation of this conflict were clashes between farmers and herdsmen competing for arable land. While farmers sought out arable land for planting activities, herdsmen required land for grazing livestock and with challenges like drought affecting farmlands, arable land became a top commodity for herdsmen. Hence, clashes ensued between the two groups and in a number of cases, these herdsmen would end up destroying farmlands once owned by farmers. Considering the level of insurgency in the North, these herdsmen have gradually begun to move down South in search of arable land for livestock (Institute for Security Studies, 2018).

In more recent times, these clashes have become increasingly violent such that the focus extends to more than the search for arable farmland; it is now “increasingly ethnic (Fulani vs other Nigerian ethnicities), religious (Muslim herders vs Christian south), and cultural (nomadic vs sedentary)” (Institute for Security Studies, 2018). The dataset from ACLED (2019) indicates that the number of fatalities from the Fulani Herdsmen conflict went up from 377 fatalities in the 2011/2012 to 2,059 fatalities in the 2014/2015 period; thus, one can observe that the activities of the herdsmen increased. The implication is that as the Boko Haram insurgency increased and led to food insecurity, this food insecurity led to increased Fulani Herdsmen activities, thereby worsening the food security conditions in the country. Given these reasons, it is plausible that omitting this variable in the model may have influenced the results, thus making them statistically insignificant.

Going back to the results, households living in the South East and South-South have a higher probability of attaining food security relative to households living in the North Central regions with marginal effects of 0.05399 and 0.05632 respectively, although the results for South-South are not statistically significant. Conversely, amongst the other zones, the South West is the region in which households have a lower probability of attaining food security, by 2.7 percentage points. Although not statistically significant, it could be possible that there are other interactions not accounted for affecting households in this region, especially when one considers that this is not a conflict zone, and the majority of urban areas are situated in this region.

In contrast to the results obtained for 2012, I observe that a household with a higher degree has the highest probability of being food secure relative to the reference group as well as other educational degrees. The results indicate that the probability of being food secure is higher than a household with an educational degree below secondary school by approximately 12 percentage points. This is in line with expectations that with each additional degree attained, a household is more likely to be food secure. Likewise, the results also show that households that use informal accounts to maintain their finances have a higher probability of being food secure relative to households without an account, by 2.82 percentage points.

Regarding food prices, a similar pattern is observed for garri prices as in 2012. However, the results this time are not statistically significant. The results for the price of beans, on the other hand, indicate that, as beans prices increase, the probability of being food secure decreases. The probability of food security is lower by 0.046 percentage points. With rice prices, the case is the reverse – the higher the price of rice, the higher the probability of food security by 0.039 percentage points. Although rice is a normal good and has substitutes, for many Nigerians, there is no substitute for rice consumption, hence it could explain why expenditures on rice

would increase and lead to food security. Interestingly, the average predicted probability of all individuals in the sample being food secure is 25.3 percentage points, which is an improvement from 2012.

In terms of the goodness of fit of this model, using McFadden's R-squared measure, the independent variables have some explanatory power, as I observe a pseudo R-squared value of 0.55. At the 1% level of significance, the Chi-squared values are also statistically significant. Additionally, I observe the percent correctly predicted for the binary outcome; the results indicate that 89.02% of observations are correctly classified.

Although the studies of Adepoju and Adejare (2013) focus on rural households in Nigeria, the majority of their findings coincide with the results of this study. In terms of gender, they observe that female-headed households have a higher probability of being food-secure relative to male-headed households. Regarding the marital status of households, households with married heads are have a lower probability of being food-secure relative to those unmarried. The results of household size, dependency ratio, occupation and non-food expenditures are also similar to the results of this study. On the other hand, they find that households living in rural areas located in the Northern regions have a higher probability of being food-insecure relative to the Southern regions, but in the case of this study, the results are not as conclusive. This could be as a result of this study focusing on households living in both rural and urban areas.

### **6.3 Additional Estimations**

Given that 2015 records a higher number of fatalities relative to 2012, I use the dataset from 2015 to estimate two different models, to determine if they predicts the binary outcome better than the previous models. From the GHS panel survey, I choose two food security related questions asked from the model that could be used as a measure of food accessibility: *Have*

*been faced with a situation when you didn't have enough to feed hh? How many days had to reduce the number of meals?*

Using these questions, I create 0-1 dummy variables such that, if a household has not reduced the number of meals or faced a situation where they did not have enough to feed the household, it has a value of 0, otherwise one. Thus, the binary outcomes for these estimations differ from the previous estimations. The dependent variable takes a value of 0 for food secure households and a value of 1 for food insecure households. As mentioned previously, I adjust conflict events such that the relevant period begins on 23<sup>rd</sup> September 2015 and ends on the 30<sup>th</sup> of September 2015. With the time frame of conflict events being quite short, I add an additional variable (number of attacks) to the model that could improve the explanatory power of the model. These results can be found in table 16 of the appendix.

Firstly, I observe that these models do not predict the outcomes of food security better than the previous model as the pseudo R-squared values are lower than the original model. In the case of the question asking whether households have enough to feed the household, the pseudo R-squared value is 0.135. When the dependent variable is based on households reducing the number of meals consumed, the pseudo r-squared value is 0.142. Additionally, I drop the North West region from the model due to collinearity reasons.

With the inclusion of only Boko Haram activity in the model, I observe that households in Boko Haram affected areas have a higher probability of food insecurity relative to the reference group by 34.9 percentage points. So far, this is the largest impact of conflict on the food security status of households that has been recorded in this study. The implication is that Boko Haram activities affect the days households didn't have enough to eat, rather than their expenditures on food. Adding the number of fatalities and attacks to the model, I observe that the marginal effect of Boko Haram activity drops to 20.65 percentage points. For attacks, the results

illustrate that the higher the number of attacks experienced, the higher probability of households being food insecure, by 6.7 percentage points. Given that the result is statistically significant at the 1% level of significance, one could infer that the number of attacks increases the probability of experiencing food insecurity by more than the number of fatalities experienced. The number of fatalities, on the other hand, seems to reduce food insecurity.

However, in this model, the variables age, area of residence, marital status and household size are not statistically significant. Regarding education, the results highlight that households with a bachelor's degree and a higher degree have a lower probability of experiencing food insecurity relative to the reference group by 9.58 and 14.32 percentage points respectively. Interestingly, I find that comparing two households who differ only in that one's educational status is a quranic education while the other has none, the household with a quranic education has a lower probability of being food insecure by 16.6 percentage points. This is higher than the probability expected for a household with a higher degree. Considering that quranic education is different from a formal education, it could be that there are other factors affecting quranic education that are omitted from the model. The coefficient estimates for food prices in this model are all statistically significant at the 1% level, indicating that food prices have an impact on the food security status of households.

The results in columns 5 to 8 present the results for a model in which the food security measure is based on number of days the household had to reduce the number of meals. From these results, I observe a similar pattern to the results of the previous model. Without other measures of conflict, I observe that households in Boko Haram affected areas have a higher probability of being food insecure by up to 47.81 percentage points. When number of fatalities and attacks are included in the model, the magnitude of the effect of Boko Haram activity decreases. The probability that households will be food insecure increases by 0.05816 as the number of attacks

increase. The number of fatalities, on the other hand, has no impact on the food security status of households. In this model, the results indicate that households living in the South East and South West have lower probabilities of being food-insecure relative to the reference group. The results for educational status differ between the two models in that only having high school education has a statistically significant effect. Food prices also indicate the same general effects, in that as the prices of garri and rice increase, the lower the probability that households would be food insecure, while for beans, as their price increases, the probability of experiencing food insecurity increases.

## **7. Conclusion**

This study seeks to determine the impact of the Boko Haram insurgency on Food security in Nigeria given the ongoing food insecurity crises in the country. Using per capita food expenditure as a proxy for measuring food security, it focuses on the food accessibility dimension. The data used in this study are obtained from the 2012 and 2015 General Household Survey (GHS). The scope of the data is, however, restricted to the post-planting seasons as they mirror “normal” food supply conditions. Conflict data is drawn from the Armed Conflict Location & Event Data Program (ACLED) for the respective years being studied.

To analyze the impact of the insurgency, I adapt a food security index by Adepoju and Adejare (2013) modeled on Foster, Greer and Thorbecke’s (FGT) poverty index which analyzes food security on a scale of 0 to 1, with 0 representing food-secure households and 1 representing food-insecure households. Then I employ a probit model which includes conflict as well as other household and socioeconomic characteristics that can determine the food security status of households.

From the descriptive statistics, I observe that the majority of households living in the Northern regions are food-insecure relative to those living in the South; and between 2012 and 2015, I observe increases in the number of households that are insecure. Interestingly, the largest number of households experiencing food insecurity are from the North West, not the North East as anticipated. This could be a result of under-reporting from households in the North East. The food security index indicates that Boko Haram activities affect the food security status of households. Nevertheless, the difference between households reporting these activities and those who do not is minimal. In 2012, the difference between these households in terms of the incidence of food insecurity is 0.04. Conversely, in 2015, households in conflict-affected regions appear to be better off as they report a lower incidence of insecurity relative to non-conflict affected households.

The results from the probit model illustrate that households in conflict-affected regions have a higher probability of being food secure than the reference group, by 2.46 percentage points. In 2015, I observe that households in areas that record Boko Haram activity have a lower probability of being food secure by 0.215 percentage points. However, these latter results are insignificant. Changing the measure of food security, I find that the Boko Haram insurgency has a significant impact on the food security status of households. For instance, regarding the number of days households didn't have enough to eat, I find that households in Boko Haram affected areas have a higher probability of being food insecure relative to the reference group by 34.9 percentage points. Additionally, I observe that the number of fatalities recorded in conflict regions does not have a significant impact on food insecurity; rather, the number of attacks greatly influences food insecurity.

There are a few limitations to this study. Considering that the results rely on cross-sectional data, the paper may have an endogeneity problem with respect to determinants like marital

status and the educational attainment of households – especially as the results indicate variability between the years studied. Likewise, this study does not control for consumer price inflation which could affect food expenditures and food prices. Hence, a panel data approach would be more suited to control for these effects. In addition, I observe that using a different measure for food security and conflict yields more significant results than the initial measure utilized by the study. Therefore, further studies may benefit from accessing other dimensions and measures of food security to effectively determine the impact of the insurgency on food security. Considerations for how conflict may affect the measure of food security would be critically analyzed before choosing a metric to measure food security. Finally, researchers could limit their studies to specific regions of the country, given that there are factors unique to specific regions that have been unaccounted for.

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## Appendix

**Table 1. Frequency Distribution of Respondents by Geo-political zone**

Zone	2012			2015		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
North Central	755	16.47	16.47	798	17.38	17.38
North East	721	15.73	32.19	634	13.81	31.19
North West	857	18.69	50.88	872	18.99	50.19
South East	757	16.51	67.39	759	16.53	66.72
South South	734	16.01	83.4	748	16.29	83.01
South West	761	16.6	100	780	16.99	100
<b>Total</b>	<b>4585</b>	<b>100</b>		<b>4591</b>	<b>100</b>	

**Table 2. Frequency Distribution of Households by Sector**

Sector	2012			2015		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Urban	1429	31.17	31.17	1460	31.8	31.8
Rural	3156	68.83	100	3131	68.2	100
<b>Total</b>	<b>4585</b>	<b>100</b>		<b>4591</b>	<b>100</b>	

**Table 3. Frequency Distribution by Gender of Head of Household**

Gender of hh	2012			2015		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Male	3865	84.3	84.3	3675	80.05	80.05
Female	720	15.7	100	916	19.95	100
<b>Total</b>	<b>4585</b>	<b>100</b>		<b>4591</b>	<b>100</b>	

**Table 4. Frequency Distribution by Marital Status of Head of Household**

Marital Status of hh	2012			2015		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
1. Married (Monogamous)	2876	62.73	62.73	2596	56.55	56.55
2. Married (Polygamous)	774	16.88	79.61	854	18.6	75.15
3. Informal Union	9	0.2	79.8	3	0.07	75.21
4. Divorced	44	0.96	80.76	51	1.11	76.32
5. Separated	98	2.14	82.9	104	2.27	78.59
6. Widowed	634	13.83	96.73	834	18.17	96.75
7. Never Married	150	3.27	100	149	3.25	100
<b>Total</b>	<b>4585</b>	<b>100</b>		<b>4591</b>	<b>100</b>	

**Table 5. Frequency Distribution of Major Income Generating Activity of Households**

Occupation	2012			2015		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Agricultural activities	2167	60.03	60.03	2481	64.26	64.26
Non-agricultural activities	1443	39.97	100	1380	35.74	100
<b>Total</b>	3610	100		3861	100	

**Table 6. Frequency Distribution by Educational Attainment of Household**

Highest Educational Status of Household	2012			2015		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Below Secondary	715	17.99	17.99	651	16.25	16.25
Secondary	1,902	47.85	65.84	1961	48.94	65.19
Diploma	541	13.61	79.45	594	14.82	80.01
Bachelor's	314	7.9	87.35	301	7.51	87.52
Higher Degree	87	2.19	89.53	115	2.87	90.39
Quaranic	416	10.47	100	385	9.61	100
<b>Total</b>	3975	100		4007	100	

**Table 7. Frequency Distribution by Age of Head of Household**

Age of hh	2012			2015		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
27 and below	96	2.09	2.09	90	1.96	1.96
28-37	749	16.34	18.43	604	13.16	15.12
38-47	1049	22.88	41.31	1107	24.11	39.23
48-57	1041	22.7	64.01	1094	23.83	63.06
58-67	781	17.03	81.05	886	19.3	82.36
68 and above	869	18.95	100	810	17.64	100
<b>Total</b>	4585	100		4591	100	

**Table 8. Frequency Distribution by Bank Account Ownership**

Ownership of Bank Account in Household	2012			2015		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
No	3125	68.26	68.26	2838	61.9	61.9
Yes	1453	31.74	100	1747	38.1	100
<b>Total</b>	4578	100		4585	100	

**Table 9. Frequency Distribution of Households Borrowing Credit Denied**

<b>Access to borrowing credit denied</b>	<b>2012</b>			<b>2015</b>		
	<b>Freq.</b>	<b>Percent</b>	<b>Cum.</b>	<b>Freq.</b>	<b>Percent</b>	<b>Cum.</b>
<b>No</b>	3908	85.46	85.46	3547	94.01	94.01
<b>Yes</b>	665	14.54	100	226	5.99	100
<b>Total</b>	4573	100		3773	100	

**Table 10. Frequency Distribution of Food Security Status by Geo-political zones**

<b>Zone</b>	<b>2012</b>			<b>2015</b>		
	<b>Insecure</b>	<b>Secure</b>	<b>Total</b>	<b>Insecure</b>	<b>Secure</b>	<b>Total</b>
<b>North Central</b>	586	159	745	618	180	798
<b>North East</b>	593	123	716	548	86	634
<b>North West</b>	740	109	849	788	84	872
<b>South East</b>	512	235	747	447	312	759
<b>South South</b>	477	229	706	422	326	748
<b>South West</b>	386	300	686	443	337	780
<b>Total</b>	3294	1155	4449	3266	1325	4591

**Table 11. Food (In)Security Status of Households based on the Food Security Index**

Category	2012			2015		
	Incidence(F0)	Depth(F1)	Severity(F2)	Incidence(F0)	Depth(F1)	Severity(F2)
Nigeria	0.74	0.47	0.30	0.71	0.46	0.30
<b>Zone</b>						
North						
Central	0.79	0.49	0.31	0.77	0.61	0.33
North East	0.83	0.59	0.41	0.86	0.72	0.50
North West	0.87	0.59	0.40	0.90	0.79	0.46
South East	0.69	0.43	0.27	0.59	0.40	0.20
South South	0.68	0.42	0.26	0.56	0.38	0.19
South West	0.56	0.29	0.15	0.57	0.32	0.16
<b>Sector</b>						
Urban	0.61	0.32	0.17	0.58	0.31	0.17
Rural	0.79	0.54	0.37	0.77	0.62	0.37
<b>Gender</b>						
Male	0.79	0.51	0.33	0.77	0.51	0.34
Female	0.50	0.28	0.16	0.46	0.26	0.15
<b>Education</b>						
Below						
Secondary	0.73	0.48	0.32	0.68	0.46	0.31
Secondary	0.78	0.50	0.32	0.76	0.48	0.31
Diploma	0.71	0.42	0.25	0.65	0.42	0.27
Bachelor's	0.63	0.32	0.16	0.53	0.28	0.14
Higher						
Degree	0.58	0.30	0.15	0.53	0.28	0.15
Quaranic	0.90	0.63	0.45	0.94	0.68	0.50
<b>Marital Status</b>						
Married	0.82	0.53	0.35	0.81	0.54	0.36
Single	0.43	0.24	0.14	0.41	0.23	0.13
<b>Age</b>						
27 and						
below	0.39	0.21	0.11	0.50	0.28	0.16
28-37	0.68	0.40	0.23	0.68	0.41	0.25
38-47	0.84	0.56	0.37	0.81	0.55	0.38
48-57	0.82	0.55	0.36	0.79	0.54	0.36
58-67	0.71	0.45	0.28	0.66	0.42	0.26
68 and						
above	0.63	0.39	0.24	0.57	0.35	0.21
<b>Occupation</b>						
Agricultural						
activities	0.83	0.58	0.41	0.83	0.69	0.40
Non-						
agricultural						
activities	0.72	0.42	0.25	0.61	0.44	0.20
<b>Boko Haram Activity</b>						
No	0.72	0.45	0.28	0.72	0.48	0.32
Yes	0.76	0.50	0.32	0.70	0.45	0.28

**Table 12. Description of Explanatory Variables**

<b>Determinant</b>	<b>Explanatory Variable</b>	<b>Description</b>
Boko Haram Activity	d_bha	d_bha=1 if respondent reports Boko Haram activity, 0 otherwise
Gender	male	Male =1 if the respondent is male, otherwise 0
Sector	urban	Urban =1 if the respondent resides in an urban area, otherwise 0
Marital Status	married	married =1 if respondent is married, 0 otherwise
Occupation	occupation	occupation = 1 if respondent is engaged in non-agricultural activity, 0 otherwise
Age	agebelow27* age2837 age3847 age4857 age5867 ageabove68	agebelow27 =1 if the respondent is age 27 or below, 0 otherwise age2837 =1 if the respondent is between ages 28 and 37, 0 otherwise age3847 =1 if the respondent is between ages 38 and 47, 0 otherwise age4857 =1 if the respondent is between ages 48 and 57, 0 otherwise age5867 =1 if the respondent is between ages 58 and 67, 0 otherwise ageabove68 =1 if the respondent is age 68 or above, 0 otherwise
Education	below secondary* secondary diploma bachelor h_degree quranic	below secondary =1 if household's highest degree is below secondary school, 0 otherwise secondary =1 if household's highest degree is secondary school, 0 otherwise diploma = 1 if household's highest degree is a diploma/certificate from a training school/technical school/polytechnic, 0 otherwise bachelor =1 if household's highest degree is a bachelor's degree, 0 otherwise h_degree= 1 if household's highest degree is above a bachelor's degree, 0 otherwise quranic = 1 if household's highest degree is quranic (specifically for learning about Islamic theology and religious law), 0 otherwise
Financial status	bank_acc cooperative informal borrow_denied borrow_friends borrow_informal borrow_inst	bank_acc = 1 if household has a bank account, 0 otherwise cooperative = 1 if household has a cooperative account, 0 otherwise informal =1 if household has an informal account, 0 otherwise borrow_denied = 1 if household has been denied from borrowing credit, 0 otherwise borrow_friends = 1 if household has borrowed from friends/family, 0 otherwise borrow_informal = 1 if household has borrowed from the informal sector (ajo, esusu, adashi), 0 otherwise borrow_inst = 1 if household has borrowed from a financial institution (banks/microfinance/ cooperatives/savings association), 0 otherwise
Food Prices	beans_price rice_price garri_price	price of beans(white beans) price of rice(imported) - local rice prices were unavailable for all states hence, imported rice price of garri(white garri)
Weather	rainfall	annual mean precipitation (milimeters)

	temp	annual mean temperature (degrees celcius x100)
Non-Food Expenditure	pc_nfexp	per capita non-food expenditure - expenditure on maintenance, education, transportation, utilities, etc.
Household	hhsz	household size
	dependency ratio	dependency ratio = number of household members actively engaged in labour activity/household size
Fatalities	fatalities	number of deaths recorded in a full post-planting period
	fatalities_new	number of deaths recorded a week before the survey begins
	avgfph	average fatality per household = total number of fatality per state/total number of households per state
	attacks	total number of attacks - attacks refer to all events tagged attack, suicide bombing, armed clash, violent demonstration
Zone	North Central*	North Central =1 if the respondent resides here, 0 otherwise
	North East	North East =1 if the respondent resides here, 0 otherwise
	North West	North West =1 if the respondent resides here, 0 otherwise
	South East	South East =1 if the respondent resides here, 0 otherwise
	South South	South South =1 if the respondent resides here, 0 otherwise
	South West	South West =1 if the respondent resides here, 0 otherwise

Note: An asterisk indicates that this group is the reference group.

**Table 13. Summary Statistics**

Variable	2012					2015				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
fs status	4449	0.26	0.438	0	1	4591	0.289	0.453	0	1
d bha	4585	0.494	0.5	0	1	4591	0.5	0.5	0	1
fatalities	4585	59.665	111.969	0	463	4591	268.543	1064.872	1	7609
avgfph	4585	0.536	1.007	0	4.372	4591	3.051	14.136	0.01	101.453
d married	4585	0.798	0.402	0	1	4591	0.752	0.432	0	1
d male	4585	0.843	0.364	0	1	4591	0.8	0.4	0	1
d urban	4585	0.312	0.463	0	1	4591	0.318	0.466	0	1
NorthCentral	4585	0.165	0.371	0	1	4591	0.174	0.379	0	1
NorthEast	4585	0.157	0.364	0	1	4591	0.138	0.345	0	1
NorthWest	4585	0.187	0.39	0	1	4591	0.19	0.392	0	1
SouthEast	4585	0.165	0.371	0	1	4591	0.165	0.372	0	1
SouthSouth	4585	0.16	0.367	0	1	4591	0.163	0.369	0	1
SouthWest	4585	0.166	0.372	0	1	4591	0.17	0.376	0	1
belowsecondary	4585	0.156	0.363	0	1	4591	0.142	0.349	0	1
secondary	4585	0.415	0.493	0	1	4591	0.427	0.495	0	1
diploma	4585	0.118	0.323	0	1	4591	0.129	0.336	0	1
bachelor	4585	0.068	0.253	0	1	4591	0.066	0.248	0	1
h degree	4585	0.019	0.136	0	1	4591	0.025	0.156	0	1
quranic	4585	0.091	0.287	0	1	4591	0.084	0.277	0	1
agebelow27	4585	0.021	0.143	0	1	4591	0.02	0.139	0	1
age2837	4585	0.163	0.37	0	1	4591	0.132	0.338	0	1
age3847	4585	0.229	0.42	0	1	4591	0.241	0.428	0	1
age4857	4585	0.227	0.419	0	1	4591	0.238	0.426	0	1
age5867	4585	0.17	0.376	0	1	4591	0.193	0.395	0	1
above68	4585	0.19	0.392	0	1	4591	0.176	0.381	0	1
occupation	3610	0.4	0.49	0	1	3861	0.357	0.479	0	1
borrow denied	4573	0.145	0.353	0	1	3773	0.06	0.237	0	1
borrow friends	4573	0.258	0.438	0	1	4591	0.055	0.228	0	1
borrow informal	4574	0.168	0.374	0	1	4591	0.057	0.231	0	1
borrow inst	4574	0.061	0.239	0	1	4591	0.071	0.256	0	1
bank acc	4578	0.317	0.466	0	1	4585	0.381	0.486	0	1
informal	4575	0.356	0.479	0	1	4585	0.414	0.493	0	1
cooperative	4576	0.094	0.292	0	1	4584	0.108	0.31	0	1
pc nfexp	4449	13489.42	48257.53	79.59	1286399	4590	22748.88	70395.15	120	1919645
hhsize	4449	5.809	3.162	1	31	4590	5.823	3.299	1	31
beans price	4585	272.764	179.911	45.31	1462.5	4591	219.727	114.391	40	498.846
rice price	4585	272.969	180.781	43	566.667	4591	299.554	173.476	46.364	584.444
garri price	4585	190.741	305.5	14.62	2275	4591	202.23	120.941	33.692	692.727
rainfall	4582	1449.992	641.677	324	3906	4591	1464.15	637.217	356	3901
temp	4582	263.52	9.157	220	288	4591	263.669	9.195	220	288
dependency_r	4378	42.965	26.685	4.167	100	4590	39.85	36.026	0	500
fatalities new						1785	8.931	15.768	0	48
attacks						1785	1.444	1.817	0	6
d_bha_new						1785	0.139	0.346	0	1
f reduce						4586	0.305	0.461	0	1
f nenough						4587	0.267	0.442	0	1

**Table 14. Probit Regression results for 2012**

VARIABLES	(1) Probit estimates	(2) Probit estimates	(3) Probit estimates	(4) Marginal Effects
d_bha	0.12744* (0.076)	0.16651** (0.084)	0.16651** (0.082)	0.02455** (0.012)
fatalities		0.00078 (0.001)	0.00078 (0.001)	0.00012 (0.000)
avgfph		-0.12641 (0.095)	-0.12641 (0.088)	-0.01867 (0.013)
married	-0.28200** (0.142)	-0.28163** (0.142)	-0.28163** (0.123)	-0.04470** (0.021)
male	-0.07240 (0.150)	-0.06810 (0.150)	-0.06810 (0.129)	-0.01023 (0.020)
urban	0.25815*** (0.085)	0.26234*** (0.085)	0.26234*** (0.088)	0.04056*** (0.014)
NorthEast	0.48179*** (0.164)	0.43918*** (0.167)	0.43918*** (0.160)	0.07041** (0.028)
NorthWest	0.44938*** (0.166)	0.39952** (0.170)	0.39952** (0.166)	0.06257** (0.027)
SouthEast	-0.33292* (0.197)	-0.37785* (0.207)	-0.37785* (0.208)	-0.05176** (0.026)
SouthSouth	-0.34210 (0.238)	-0.36073 (0.243)	-0.36073 (0.240)	-0.04936 (0.030)
SouthWest	-0.12481 (0.131)	-0.09966 (0.133)	-0.09966 (0.128)	-0.01437 (0.018)
secondary	-0.00116 (0.091)	0.00020 (0.091)	0.00020 (0.085)	0.00003 (0.013)
diploma	-0.08342 (0.135)	-0.08587 (0.135)	-0.08587 (0.141)	-0.01242 (0.020)
bachelor	0.11579 (0.165)	0.11907 (0.165)	0.11907 (0.178)	0.01815 (0.028)
h_degree	-0.11258 (0.287)	-0.11494 (0.287)	-0.11494 (0.374)	-0.01642 (0.052)
quranic	-0.08177 (0.139)	-0.08062 (0.139)	-0.08062 (0.151)	-0.01169 (0.021)
age2837	-0.14928 (0.212)	-0.14910 (0.212)	-0.14910 (0.194)	-0.02147 (0.027)
age3847	-0.33319 (0.214)	-0.33317 (0.214)	-0.33317* (0.197)	-0.04704* (0.027)
age4857	-0.37857* (0.216)	-0.38188* (0.216)	-0.38188* (0.202)	-0.05330** (0.027)
age5867	-0.38215* (0.216)	-0.37924* (0.216)	-0.37924* (0.198)	-0.05168** (0.025)
above68	-0.41040* (0.214)	-0.40429* (0.215)	-0.40429** (0.200)	-0.05447** (0.024)
dependency ratio	0.01176*** (0.002)	0.01181*** (0.002)	0.01181*** (0.002)	0.00174*** (0.000)
occupation	0.19034** (0.079)	0.19262** (0.079)	0.19262** (0.078)	0.02884** (0.012)
borrow_denied	0.12023 (0.103)	0.11393 (0.103)	0.11393 (0.103)	0.01724 (0.016)
borrow_friends	-0.03368 (0.087)	-0.02459 (0.087)	-0.02459 (0.085)	-0.00362 (0.012)

borrow_informal	-0.04180 (0.101)	-0.04042 (0.102)	-0.04042 (0.099)	-0.00592 (0.014)
borrow_inst	-0.02753 (0.160)	-0.02535 (0.161)	-0.02535 (0.151)	-0.00372 (0.022)
informal	0.12931 (0.081)	0.12735 (0.081)	0.12735* (0.077)	0.01899 (0.012)
cooperative	0.06022 (0.130)	0.06672 (0.130)	0.06672 (0.132)	0.01001 (0.020)
bank_acc	0.32624*** (0.093)	0.32526*** (0.093)	0.32526*** (0.094)	0.05039*** (0.015)
pc_nfexp	0.00004*** (0.000)	0.00004*** (0.000)	0.00004*** (0.000)	0.00001*** (0.000)
hhsz	-0.28725*** (0.024)	-0.28707*** (0.024)	-0.28707*** (0.038)	-0.04240*** (0.005)
beans_price	-0.00025 (0.000)	-0.00032 (0.000)	-0.00032 (0.000)	-0.00005 (0.000)
rice_price	-0.00033 (0.000)	-0.00037 (0.000)	-0.00037 (0.000)	-0.00005 (0.000)
garri_price	0.00031*** (0.000)	0.00029** (0.000)	0.00029*** (0.000)	0.00004*** (0.000)
rainfall	-0.00001 (0.000)	-0.00003 (0.000)	-0.00003 (0.000)	-0.00001 (0.000)
temp	0.00208 (0.004)	0.00031 (0.004)	0.00031 (0.004)	0.00005 (0.001)
Constant	-0.51674 (1.063)	0.03023 (1.142)	0.03023 (1.095)	
Observations	3,549	3,549	3,549	3,549
Avg. Predicted Prob.	0.21514***	0.21519***	0.21519***	
Pseudo-R <sup>2</sup> :	0.500	0.500	0.500	
Log-Likelihood:	-922.8	-921.5	-921.5	
Chi-squared	1844	1846	602	
Prob > Chi2:	0.000	0.000	0.000	

Note: Column 1 reports the results with only the inclusion of Boko Haram activity. Column 2 includes fatalities and average fatalities per households in each state. Column 3 clusters the variables at the household level. Standard errors are reported in parentheses for columns 1 and 2, while 3 reports robust standard errors. Column 4 reports the marginal effects. From the OLS regressions, the mean VIF values were 3.70. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 15. Probit Regression results for 2015**

VARIABLES	(1) Probit estimates	(2) Probit estimates	(3) Probit estimates	(4) Marginal Effects
d_bha	-0.01975 (0.083)	-0.01483 (0.084)	-0.01483 (0.086)	-0.00215 (0.012)
fatalities		-0.00002 (0.000)	-0.00002 (0.000)	-0.00000 (0.000)
married	-0.31386** (0.141)	-0.31298** (0.141)	-0.31298** (0.134)	-0.04794** (0.022)
male	0.14911 (0.148)	0.14909 (0.148)	0.14909 (0.142)	0.02096 (0.019)
urban	0.31131*** (0.093)	0.31352*** (0.093)	0.31352*** (0.099)	0.04704*** (0.015)
North_East	0.14091 (0.195)	0.14164 (0.195)	0.14164 (0.188)	0.02090 (0.028)
North_West	0.02318 (0.188)	0.02698 (0.188)	0.02698 (0.192)	0.00391 (0.028)
South_East	0.34859* (0.188)	0.35348* (0.189)	0.35348* (0.186)	0.05399* (0.030)
South_South	0.35648 (0.219)	0.36670* (0.222)	0.36670* (0.221)	0.05632 (0.036)
South_West	-0.20040 (0.133)	-0.19854 (0.134)	-0.19854 (0.130)	-0.02773 (0.017)
secondary	-0.03296 (0.101)	-0.03407 (0.102)	-0.03407 (0.094)	-0.00493 (0.014)
diploma	0.17952 (0.141)	0.17880 (0.141)	0.17880 (0.137)	0.02663 (0.021)
bachelor	0.11684 (0.169)	0.11523 (0.169)	0.11523 (0.172)	0.01705 (0.026)
h_degree	0.72813*** (0.225)	0.72735*** (0.225)	0.72735*** (0.257)	0.12041** (0.048)
quranic	0.08458 (0.195)	0.08260 (0.195)	0.08260 (0.201)	0.01211 (0.030)
age2837	0.09480 (0.129)	0.09476 (0.129)	0.09476 (0.123)	0.01390 (0.018)
age3847	0.13118 (0.115)	0.13057 (0.115)	0.13057 (0.106)	0.01909 (0.016)
age4857	0.07665 (0.116)	0.07669 (0.116)	0.07669 (0.110)	0.01118 (0.016)
age5867	0.13015 (0.109)	0.13078 (0.109)	0.13078 (0.111)	0.01927 (0.017)
dependency ratio	0.00430*** (0.001)	0.00429*** (0.001)	0.00429*** (0.001)	0.00062*** (0.000)
occupation	0.43600*** (0.094)	0.43565*** (0.094)	0.43565*** (0.096)	0.06565*** (0.015)
borrow_denied	-0.12742 (0.156)	-0.12775 (0.156)	-0.12775 (0.151)	-0.01803 (0.021)
informal	0.19251** (0.077)	0.19445** (0.077)	0.19445*** (0.074)	0.02828*** (0.011)
cooperative	0.00157 (0.136)	0.00172 (0.136)	0.00172 (0.135)	0.00025 (0.019)
bank_acc	0.34664*** (0.098)	0.34598*** (0.098)	0.34598*** (0.107)	0.05169*** (0.017)

pc_nfexp	0.00002*** (0.000)	0.00002*** (0.000)	0.00002*** (0.000)	0.00000*** (0.000)
hhszise	-0.39164*** (0.028)	-0.39186*** (0.028)	-0.39186*** (0.040)	-0.05667*** (0.006)
beans_price	-0.00320*** (0.001)	-0.00320*** (0.001)	-0.00320*** (0.001)	-0.00046*** (0.000)
rice_price	0.00269*** (0.001)	0.00270*** (0.001)	0.00270*** (0.001)	0.00039*** (0.000)
garri_price	0.00062 (0.001)	0.00061 (0.001)	0.00061 (0.001)	0.00009 (0.000)
rainfall	0.00019 (0.000)	0.00019 (0.000)	0.00019 (0.000)	0.00003 (0.000)
temp	0.00411 (0.004)	0.00414 (0.004)	0.00414 (0.004)	0.00060 (0.001)
Constant	-1.54084 (1.163)	-1.54490 (1.163)	-1.54490 (1.091)	
Observations	3,133	3,133	3,133	3,133
Avg. Predicted Prob.	0.25314***	0.25314***	0.25314***	
Pseudo-R <sup>2</sup> :	0.549	0.549	0.549	
Log-Likelihood:	-801.2	-801.1	-801.1	
Chi-squared	1951	1951	620.2	
Prob > Chi2:	0.000	0.000	0.000	

Note: Column 1 reports the results with only the inclusion of Boko Haram activity. Column 2 includes fatalities and average fatalities per households in each state. Column 3 clusters the variables at the household level. Standard errors are reported in parentheses for columns 1 and 2, while 3 reports robust standard errors. Column 4 reports the marginal effects. From the OLS regressions, the mean VIF values were 3.86. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 16. Additional Estimations (2015)

VARIABLES	(1) Fs_nenough Probit estimates	(2) Marginal Effects	(3) Fs_nenough Probit estimates	(4) Marginal Effects	(5) Fs_reduce Probit estimates	(6) Marginal Effects	(7) Fs_reduce Probit estimates	(8) Marginal Effects
d_bha	1.09518*** (0.217)	0.34908*** (0.062)	0.64272*** (0.310)	0.20645** (0.100)	1.58433*** (0.218)	0.47812*** (0.043)	0.92728*** (0.308)	0.31254*** (0.094)
fatalities_new			-0.01726*** (0.005)	-0.00523*** (0.002)			0.00229 (0.005)	0.00076 (0.002)
attacks			0.22147*** (0.074)	0.06707*** (0.022)			0.17431** (0.072)	0.05816** (0.024)
age2837	0.18962 (0.306)	0.05965 (0.098)	0.12416 (0.307)	0.03825 (0.096)	0.14958 (0.281)	0.05035 (0.095)	0.10789 (0.278)	0.03609 (0.093)
age3847	0.31084 (0.296)	0.09798 (0.095)	0.19574 (0.297)	0.06045 (0.093)	0.26728 (0.272)	0.08969 (0.090)	0.21006 (0.271)	0.07020 (0.090)
age4857	0.25473 (0.298)	0.07955 (0.094)	0.16353 (0.298)	0.05018 (0.092)	0.33816 (0.274)	0.11370 (0.091)	0.30412 (0.272)	0.10182 (0.090)
age5867	-0.01363 (0.301)	-0.00418 (0.092)	-0.11700 (0.302)	-0.03503 (0.089)	0.12533 (0.277)	0.04205 (0.093)	0.09954 (0.275)	0.03322 (0.092)
above68	0.29716 (0.299)	0.09405 (0.097)	0.15291 (0.302)	0.04718 (0.095)	0.38674 (0.278)	0.13092 (0.093)	0.34549 (0.278)	0.11645 (0.093)
urban	0.11065 (0.108)	0.03433 (0.034)	0.08107 (0.109)	0.02476 (0.034)	0.12337 (0.105)	0.04164 (0.035)	0.12363 (0.106)	0.04150 (0.036)
male	-0.07306 (0.174)	-0.02262 (0.055)	-0.06809 (0.172)	-0.02080 (0.053)	-0.25895 (0.167)	-0.08809 (0.057)	-0.27480* (0.167)	-0.09301 (0.057)
married	-0.10404 (0.169)	-0.03225 (0.053)	-0.11438 (0.168)	-0.03503 (0.052)	0.05827 (0.163)	0.01948 (0.054)	0.06704 (0.163)	0.02226 (0.054)
secondary	0.05994 (0.106)	0.01842 (0.033)	0.07894 (0.106)	0.02396 (0.032)	0.26125*** (0.104)	0.08835*** (0.035)	0.25087*** (0.104)	0.08437*** (0.035)
diploma	-0.16411 (0.166)	-0.04903 (0.048)	-0.11077 (0.168)	-0.03298 (0.049)	0.04497 (0.164)	0.01511 (0.055)	0.02152 (0.165)	0.00719 (0.055)
bachelor	-0.39986* (0.220)	-0.11292** (0.056)	-0.33825 (0.223)	-0.09584* (0.058)	-0.17190 (0.205)	-0.05705 (0.067)	-0.19354 (0.205)	-0.06371 (0.066)
h_degree	-0.66026**	-0.17136***	-0.53706*	-0.14324**	-0.42419	-0.13646*	-0.38265	-0.12308

quranic	(0.286) -0.59953*** (0.216)	(0.058) -0.15990*** (0.047)	(0.292) -0.63629*** (0.213)	(0.065) -0.16628*** (0.045)	(0.268) 0.17384 (0.210)	(0.081) 0.05873 (0.071)	(0.272) 0.11592 (0.209)	(0.083) 0.03888 (0.070)
pc_nfexp	-0.00000* (0.000)	-0.00000* (0.000)	-0.00000** (0.000)	-0.00000** (0.000)	-0.00000 (0.000)	-0.00000 (0.000)	-0.00000 (0.000)	-0.00000 (0.000)
hhsiz	-0.02154 (0.017)	-0.00661 (0.005)	-0.01138 (0.017)	-0.00345 (0.005)	-0.01777 (0.016)	-0.00596 (0.005)	-0.01506 (0.016)	-0.00503 (0.005)
borrow_denied	0.69777*** (0.187)	0.23072*** (0.062)	0.64987*** (0.192)	0.21196*** (0.063)	0.56310*** (0.179)	0.18896*** (0.057)	0.58304*** (0.182)	0.19452*** (0.058)
informal	-0.02210 (0.088)	-0.00678 (0.027)	0.01923 (0.090)	0.00582 (0.027)	0.14681* (0.084)	0.04930* (0.028)	0.12434 (0.085)	0.04153 (0.028)
cooperative	-0.06581 (0.175)	-0.01995 (0.052)	-0.08697 (0.176)	-0.02593 (0.052)	-0.29872* (0.175)	-0.09799* (0.055)	-0.31852* (0.178)	-0.10355* (0.055)
bank_acc	-0.24823** (0.110)	-0.07543** (0.033)	-0.29073*** (0.111)	-0.08696*** (0.032)	-0.16957 (0.107)	-0.05666 (0.035)	-0.17742 (0.109)	-0.05889* (0.036)
garr_i_price	-0.00603*** (0.002)	-0.00185*** (0.000)	-0.00759*** (0.002)	-0.00230*** (0.001)	-0.00951*** (0.002)	-0.00319*** (0.001)	-0.01211*** (0.002)	-0.00404*** (0.001)
beans_price	0.00617*** (0.002)	0.00189*** (0.000)	0.00695*** (0.002)	0.00211*** (0.001)	0.00960*** (0.002)	0.00322*** (0.001)	0.01213*** (0.002)	0.00405*** (0.001)
rice_price	-0.00490*** (0.001)	-0.00150*** (0.000)	-0.00616*** (0.001)	-0.00186*** (0.000)	-0.00740*** (0.001)	-0.00248*** (0.000)	-0.00902*** (0.001)	-0.00301*** (0.000)
rainfall	-0.00024 (0.000)	-0.00007 (0.000)	-0.00027 (0.000)	-0.00008 (0.000)	-0.00009 (0.000)	-0.00003 (0.000)	-0.00019 (0.000)	-0.00006 (0.000)
temp	0.00370 (0.006)	0.00114 (0.002)	0.01439** (0.007)	0.00436** (0.002)	0.00812 (0.006)	0.00273 (0.002)	0.00700 (0.007)	0.00233 (0.002)
occupation	0.25095** (0.107)	0.07793** (0.033)	0.23772** (0.107)	0.07288** (0.033)	0.15744 (0.105)	0.05304 (0.035)	0.16581 (0.106)	0.05553 (0.035)
North_East	1.86467*** (0.426)	0.47256*** (0.053)	1.89886*** (0.425)	0.47331*** (0.052)	0.45723* (0.238)	0.14909** (0.073)	0.29815 (0.245)	0.09803 (0.078)
South_East	0.30340 (0.581)	0.09406 (0.180)	-0.13140 (0.633)	-0.03933 (0.187)	-1.69703*** (0.494)	-0.36570*** (0.042)	-2.33425*** (0.534)	-0.39621*** (0.020)
South_South	1.55540*** (0.436)	0.41493*** (0.071)	1.60834*** (0.430)	0.42074*** (0.067)	0.35126 (0.257)	0.11842 (0.085)	0.39572 (0.254)	0.13266 (0.084)
South_West	-0.00460 (0.609)	-0.00141 (0.187)	0.05004 (0.625)	0.01529 (0.193)	-2.15245*** (0.518)	-0.41999*** (0.028)	-2.54147*** (0.537)	-0.43331*** (0.018)

dependency ratio	0.00098 (0.001)	0.00030 (0.000)	0.00123 (0.001)	0.00037 (0.000)	0.00004 (0.001)	0.00001 (0.000)	0.00012 (0.001)	0.00004 (0.000)
Constant	-1.15981 (1.806)		-3.41440* (1.970)		-0.45204 (1.768)		0.56490 (1.951)	
Observations	1,214	1,214	1,214	1,214	1,214	1,214	1,214	1,214
Pseudo-R <sup>2</sup> :	0.124		0.135		0.137		0.142	
Log-Likelihood:	-655.7		-648.1		-715.1		-711.2	
Chi-squared	127		146.7		193.8		211.7	
Prob > Chi2:	0.000		0.000		0.000		0.000	

Note: All results have been clustered at the household, therefore only robust standard errors in parentheses. Fs\_nenough refers to the question: Have been faced with a situation when you didn't have enough to feed hh? Fs\_reduce refers to: How many days had to reduce the number of meals?  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1