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► **To cite this version:**

George Abuchi Agwu. The Boko Haram conflict and food insecurity: Does resilience capacity matter?. 2020. hal-02902311

HAL Id: hal-02902311

<https://hal.science/hal-02902311>

Preprint submitted on 18 Jul 2020

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The Boko Haram conflict and food insecurity: Does resilience capacity matter?

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July 11, 2020

Abstract

Drawing from a robust identification strategy and household panel data collected before and after exposure to the Boko Haram civil conflict, this paper addresses the question of whether or not resilience capacity is an important factor in the mitigation of households risks of food insecurity in the presence of shocks. Under non-parametric difference-in-differences framework, the paper at first identifies that the shocks actively erode household food security. Ignoring the roles of resilience capacity, the basic estimates indicate that exposure to the conflict is associated with significant downward movements in all the three dimensions of food security considered. At the second, further analyses underscore resilience capacity as an active mediator of the shocks and quantifies the roles of overall resilience capacity and its various pillars. However, the processes dissipate substantial amount of resilience, thereby weakening households long-run potential to withstand shocks. The results are prescriptively unchanged after adjusting operating spatial distance of exposure or switching measure of conflict exposure to conflict intensity represented as battle fatalities. These estimates bear out the various hypotheses of the resilience approach to sustainable development. Accordingly, the main recommendation is that conflict intervention programmes focus on rebuilding resilience that might restore households ability to overcome present and future shocks.

Keywords: Boko Haram, Conflict, Food security, Resilience, Nigeria

JEL classification : D12, I30, I32

Draft

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1 Introduction

As the frequency of disasters including floods, earthquakes and violent conflicts increases mainly in developing countries, rapid response systems such as the food security early warning protocol are becoming attractive as enablers of rapid interventions ([Buchanan-Smith and Davies, 1995](#)). Although, such short term welfare interventions do calm the crises, they seldom address the underlying causes of vulnerability. On the contrary, chances exist that short term interventions induce individuals and households to serially depend on aids and handouts ([Béné,2012](#); [Béné et al.,2015](#); [Allinovi et al., 2013](#)). These concerns motivate the calls for resilience approach to development, whereby the build up of resilience capacity is a primary concern of development planning and economic assistance programmes ([Tendall et al., 2015](#)). As a construct, resilience is a "mobilising metaphor" that integrates the sectors of livelihoods, social protection, health and nutrition, all of which assist households weather negative consequences of economic shocks ([Béné et al., 2016](#)). The political economy of most developing countries is such that there is low penetration of social protection in the face of high frequency exposure to covariate shocks in the forms of natural and man-made disasters. Such settings provide the ideal environment for investigating the roles of resilience capacity during shocks. This paper aims to exploit this environment that remain under-exploited due to data limitations. The evidence from this and similar studies would inform development policies in general, and specific humanitarian interventions.

The level of household resilience capacity in times of economic shocks is theoretically regarded as the source of their welfare protection and recovery from the shocks ([Constas and Barrett,2013](#); [Allinovi et al., 2013](#)). However, this theory has not been fully investigated. Stakeholders, including the World Bank (WB), the Food and Agricultural Organisation (FAO), and the World Food programme (WFP) continue to lead efforts at harmonising the conceptual framework for the measurement of resilience capacity as an important corollary of food security. At the same time, the stakeholders request empirical assessment of the role of resilience capacity during disasters, encouraging the adoption of the harmonised conceptual framework of resilience measurement ([Frankenberger and Nelson, 2013](#)). In response, the number of studies investigating the roles of various aspects of resilience capacity under different conceptual frameworks is rising. Identifying resilience in action requires longitudinal setting that allows the exploitation of the dynamics of shocks, welfare and the intervention of resilience capacity. Nevertheless, dearth of comprehensive longitudinal data cutting across major shocks constrain most of the studies to use cross-sectional data, or omit important pillars of resilience. Except that the shocks are self-reported and subject to recall bias, the longitudinal setting in which [d'Errico et al., 2018](#) investigates the roles of resilience in food security represents the model for this paper.

In line with the above, this paper uses the shocks originating from the battles of the Boko Haram as one of the leading violent terror groups in the world to test the roles of resilience capacity in shocks mitigation. Most of the studies linking conflict and food security only investigate the short-term consequences, and assume direct cause and effect relationship between conflict shocks and food security. This study extends this literature by investigating resilience capacity as an intervention factor, and as a potential channel of extending the immediate

consequences of the conflict. The study casts resilience as an absorber of the food shocks generated by the Boko Haram conflict, and that are expected to affect household food security. By identifying that resilience cushions the effects of the conflict through its various pillars, the paper demonstrates support for the emerging resilience approach to sustainable economic development.

The remainder of the paper is organized as follows: Section 2 discusses the related literature and background of the study. Section 3 provides an overview of the data and descriptive statistics. Section 4 estimates the baseline relationships of the conflict exposure and food security, including the roles of resilience capacity. Section 5 assesses the long run components of the relationships. Section 6 reports some robustness checks, and section 7 concludes with policy recommendations.

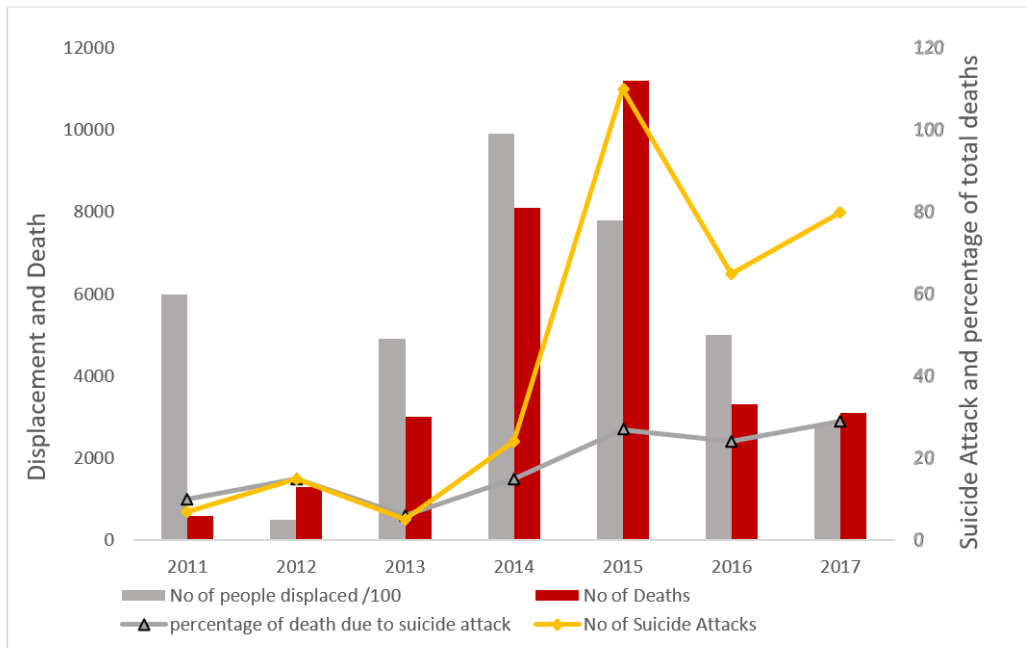
2 Literature and background of the study

2.1 The conflict

Violent conflicts such as the Boko Haram insurgency brings a lot of disruptions, including on the food systems (D'Souza and Jolliffe, 2013). The Boko Haram conflict targets important economic activities such as farming and informal trading activities, and previous studies acknowledge that this targeting pattern is behind most of its economic impact, particularly on the ability of households to access food and other livelihood resources (Falode, 2016; Adelaja and George, 2019). While the apparent objective of the Boko Haram is not directly related to the food systems, food is certainly used as a means to the end, and the food system is incidentally compromised through violent exchanges between state and the insurgents (Bertoni et al., 2019; Messer and Cohen, 2006). The Boko Haram adopts a menu of strategies to drive its objectives; first, it was through launching of battles using massive foot soldiers, annexing and occupying territories of the North east of the country. This form of attacks usually involve clashes with the state forces, and ends mostly in state victories. As from 2013, the conflict intensifies following more spirited drive of the state to recapture annexed territories and eradicate the insurgency (Onapajo and Uzodike, 2012). Consequently, the nature of the attacks appear to have become more clandestine and concentrated in less governed spaces such as farmlands and local markets.

Figure 1: Trend of Boko Haram attacks and casualties

Source: Author's computation based on data from IDMC, ACLED



The Boko Haram became a much more formidable threat on account of this covert strategy; It became the world most deadly terrorist group in terms of casualties counts (Omeni, 2018). The new strategy minimizes direct confrontation with the opposing state forces in favour of suicide attacks. Economic sabotage such as raids on farms and general disruption of essential economic activities rose with the new strategy (Campbell and Harwood, 2018). Figure 1 clearly demonstrates this transition, where suicide fatalities rose sharply beginning from 2014. One can therefore imagine the extent of disruption in the food system given as the transition focused attacks on agrarian hotspots (Onapajo, 2017). Cases of infrastructures and personal assets damages reportedly also took similar turn (Van Den Hoek, 2017). By these, the conflict scenario conforms to the classical mechanisms through which violent conflicts result to severe welfare losses, and the limitation of food production and distribution matters (Kimenyi et al., 2014; d’Errico et al., 2018).

2.2 Food security and resilience capacity

According to Spedding (1988), household is a central unit of the food system and subject to idiosyncratic and general shocks that threaten its stability. In spite of shocks, households maintain self-organisation by synergizing its components and the immediate social and economic environments. As a unit of analysis under the framework of resilience, household is the centre of all the important welfare decisions including the choice of income generating activities, the allocation of food and non-food expenditures, and the choice of risk management strategies. Hence, the forces of resilience need the agency of the households to go into action (Cherchye et al., 2007). The concept of resilience originates from the pure and ecological sciences where it is used to describe

the ability of a complex system to retain its identity and essential functions by reorganising following disturbing shocks (Holling, 1996). The complexity of the food system and its susceptibility to shocks motivated the conceptualisation of food security resilience as households ability to maintain reasonable nutritional standard despite food supply shocks (Alinovi et al., 2008). Following concerns about food security in the face of shocks, the main stakeholders in development issues assembled a group of development experts known as the technical working group on resilience measurement (TWGRM) to advise on the relationships among resilience, food security and shocks.¹ The TWGRM made a number of expert recommendations based on development theories, which serve as guides for the measurement of food security resilience and the complex network of predicting variables.

The theories of resilience and the framework of measurement used in this paper are derived from the recommendations of the TWGRM. The TWGRM defines resilience as "the capacity that ensures adverse stressors and shocks do not have long-lasting adverse development consequences" (Constas et al., 2014). By implication, resilience capacity enables households to overcome experienced shocks without suffering severe welfare consequences. The measurement of resilience as a latent construct has evolved over time and the framework developed by the TWGRM is an important stage in adapting the concept to economic development studies (d'Errico et al., 2018). The resilience construct incorporates the idea that households respond to economic shocks by drawing down on accumulated resources and utilizing available capacities in order to develop optimal coping strategies. However, this idea does not consider that the resilience resources may be directly affected in certain shocks environments such as conflict battles. In this case, conflict exposure may have both short term impact through its effects on immediate economic welfare, and potential long term impact through its effects on the resilience resources that should mitigate future shocks.

Given the TWGRM framework, household's resilience capacity depends on certain sets of social and economic conditions and attributes of the households known as the resilience pillars. They include; Access to Basic Services (ABS), Assets ownership (AST), access to Social Safety Nets (SSN) and endowed Adaptive Capacity (AC). Extensive discussion of the structures of resilience capacity with household as the unit of decision may be found in Béné et al. (2016) and Smith & Frankenberg (2018). The conceptual framework for the measurement of resilience capacity incorporating the four pillars are detailed in FAO (2016). The resilience to food insecurity requires the household to act as a resources mobilising entity for its components in order to cushion the effects of adverse stressors (Bruck et al., 2018). Household welfare protection strategies that are motivated by resilience capacity including consumption smoothing are discussed in extant development literatures (Béné et al., 2016; Hoddinott, 2006). In this study, the computation of the resilience capacity is based on the household as the sub-system of the food systems. Following the TWGRM, the computation aims at structurally combining the network of practices and mechanisms that are products of the decisions made by households experiencing shocks and the set of resources that enable them sustain welfare despite the shocks (see; Bene et al., 2016).

¹The stakeholders include the Food and Agricultural Organisation (FAO), the International Food Policy Research Institute (IFPRI) and the World Food Programme (WFP)

2.3 Relating the conflict, food security and resilience capacity

The prevailing state of conflict and humanitarian crisis in the north-east region of Nigeria is attributed to the Boko Haram insurgency. The Boko Haram on its own is rooted a complex combination of institutional failures, extreme religiosity and welfare limitations (Iyekepolo, 2016). Apparently, the general state of economic welfare including food security has taken a downward turn since the inception of the crisis. The Food and Agricultural Organisation (FAO) projects that about 3.7 million individuals would become food insecure in the region by 2018, and the World Food programme (WFP) estimates that out of the 14.8 million people exposed to the crisis, about 8 million have become food insecure (FAO, 2018; WFP, 2017). In the region where households usually produce most of their consumption, market dependence for food supplies has risen, and a large number of households report inability to purchase their desired quantity of foods due to diminished earnings and rising food prices. As a result, food provisioning strategies such as relying on less preferred foods, skipping meals and so forth has risen among the exposed households who are desperately attempting to survive the conflict (World Bank, 2018).

Unlike other settings of shocks, "food wars" are usually involved in civil conflicts whereby food supply is targeted as a weapon by actors in the conflict. The "Boko Haram" (BH) insurgency emerged primarily as active militancy against forms of education that are not adherent to the Islamic principles. However, the Boko Haram over-reaches and targets the destruction assets and essential facilities in driving this aim. Millions of people have been displaced from their homes and thousands killed in the course of the war (Adelaja and George, 2019). The insurgency group employs diverse means in the struggle against the state, one of which is the widely condemned kidnap of about 300 high school girls in 2014 (Iyekepolo, 2016). Of most concern for this study is the targeting of agricultural production through the kidnapping of farmers and the destruction of farm infrastructures such as irrigation and storage facilities. In addition, the BH targets and destroys markets, roads, bridges, and other factors that constitute enabling environment for the production and distribution of foods (Campbell, 2018). These have raised the concern of stakeholders about possible long term damages to economic welfare (FAO 2017; WFP 2017).

The set of pioneer empirical studies of this conflict have already found evidence of food supply shortages occurring through substantial loss of agricultural production (Adelaja and George, 2019). It is therefore no surprise that widespread food insecurity has followed (George et al, 2019). Other than food supply, other related outcomes, particularly those relating to the essential dimensions of resilience have also suffered the consequences of the conflict. However, despite the important theoretical roles of

resilience in this setting, the behaviours of resilience in this region and time is yet to be systematically investigated. The study by [Bertoni et al \(2019\)](#) points to a substantial decrease in human capital accumulation arising from the destruction of schooling infrastructures and threats to life. Similarly, [Ekhator-Mobayode et al., \(2019\)](#) and [Chukwuma and Ekhator-Mobayode, \(2019\)](#) document non-trivial decrease in the production and consumption of health services. No doubt, these findings suggest that resilience of the households might have been affected, at least in parts. In theory, the reduction of resilience capacity makes the households vulnerable to shocks and potentially expose them to food insecurity. The direct loss of income or income sources and/or scarcity of food classically defines food insecurity vulnerability. However, if the conflict destroys essential infrastructures, it opens another source of vulnerability by forcing the households to spend more on essential services at the expense of food consumption. For example, inadequate supply of health services could increase the frequencies of illnesses and draw down on household food consumption budget. Incidentally, cases of epidemics are already being reported in communities exposed to the Boko Haram conflict ([Adamu et al., 2019](#)).

It has already been stressed that the relationships between shocks, resilience and food security is complex, especially when resilience capacity is potentially targeted by the shocks ([Constas and Barrett, 2013](#); [Béné et al., 2016](#); [Smith and Frankenberger, 2018](#)). While many types of shocks including natural disasters compromise household food security, resilience capacity absorbs the shocks and cushions their effects on the households. However, some pillars of resilience are expected to be targeted systematically during conflicts. In this context, it would interest policy makers to understand the immediate effects of the conflict on food security, and the longer term effects on the resilience capacity. This paper stands out through the investigation of the role of resilience in the context of violent conflict that compromises food security and resilience capacity simultaneously. While previous studies document negative effects of shocks on food security they demonstrate that resilience capacity intervenes by wholly or partially absorbing the food supply shocks thereby protecting the households from adverse consequences including food insecurity. Investigating the 2014 catastrophic floods in Bangladesh, [Smith and Frankenberger \(2018\)](#) demonstrates this strategic role of resilience capacity and emphasizes the importance of absorptive, adaptive and transformative pillars of resilience in safeguarding household food security. Specifically, assets holdings, livelihood diversity, access to basic services and social safety nets assist in the maintenance of food security despite the food shortage occasioned by the floods. [Bruck et al. \(2018\)](#) demonstrates similar pattern of resilience mediation in the case of the Israel-Palestine conflict at the Gaza strip. The study identifies social safety nets and access to basic services as

important dimensions of resilience that attenuate the welfare reducing effects of the conflict. The same mechanism operates also in the case of idiosyncratic shocks as self-reported by the households. For this case, [d’Errico et al. \(2018\)](#) identifies the cushioning effects of resilience capacity, particularly the adaptive capacity.

The present study contributes to this strand of literature in a number of ways: it measures the roles of resilience capacity in the time of conflict using robust difference-in-differences strategy based on the timing of successive conflict battles. In the end, the study identifies the short term and potential long term effects of exposure to the conflict.

3 Data

3.1 Conflict in the neighbourhood of households

Overall, the empirical strategy relies on the difference-in-differences estimator (DiD) to identify the effects of exposure to the conflict on the relevant outcomes. As a result, this section adapts the estimation data to the DiD estimation set-up including the main assumption of parallel trend. In order to create the required treatment and control groups, the relevant households are classified as exposed and not exposed based on their proximity to the Boko Haram conflict battles. Under this type of classification, the parallel trend assumption may be violated due to certain time varying economic conditions that predispose locations to conflicts such as poverty ([Abadie, 2006](#); [Miguel and Satyanath, 2011](#); [Pinstrup-Andersen and Shimokawa, 2008](#)). To mitigate this, the dynamic spatial extension of the conflict is closely monitored and used to pick out the locations to be included in each of the exposed and control groups. This mitigation requires that each of the designated treatment and control group experiences exposure to the conflict, but during different data collection rounds. This manoeuvre potentially mitigates endogenous selection into conflict exposure because economic conditions in exposed locations are likely to be comparable, irrespective of time of exposure. Hence, the identification relies on variation in the timing of exposure and successive data collection rounds. The data selection process is as described below:

The first three waves of the Nigerian Living Standard Measurement Survey (LSMS) collected by the World Bank and the Nigeria’s national bureau of statistics (NBS) is used in the study. The nationally representative LSMS panel contains comprehensive information on household socio-demographic characteristics and consumption, including dedicated module for food security. The periods covered by

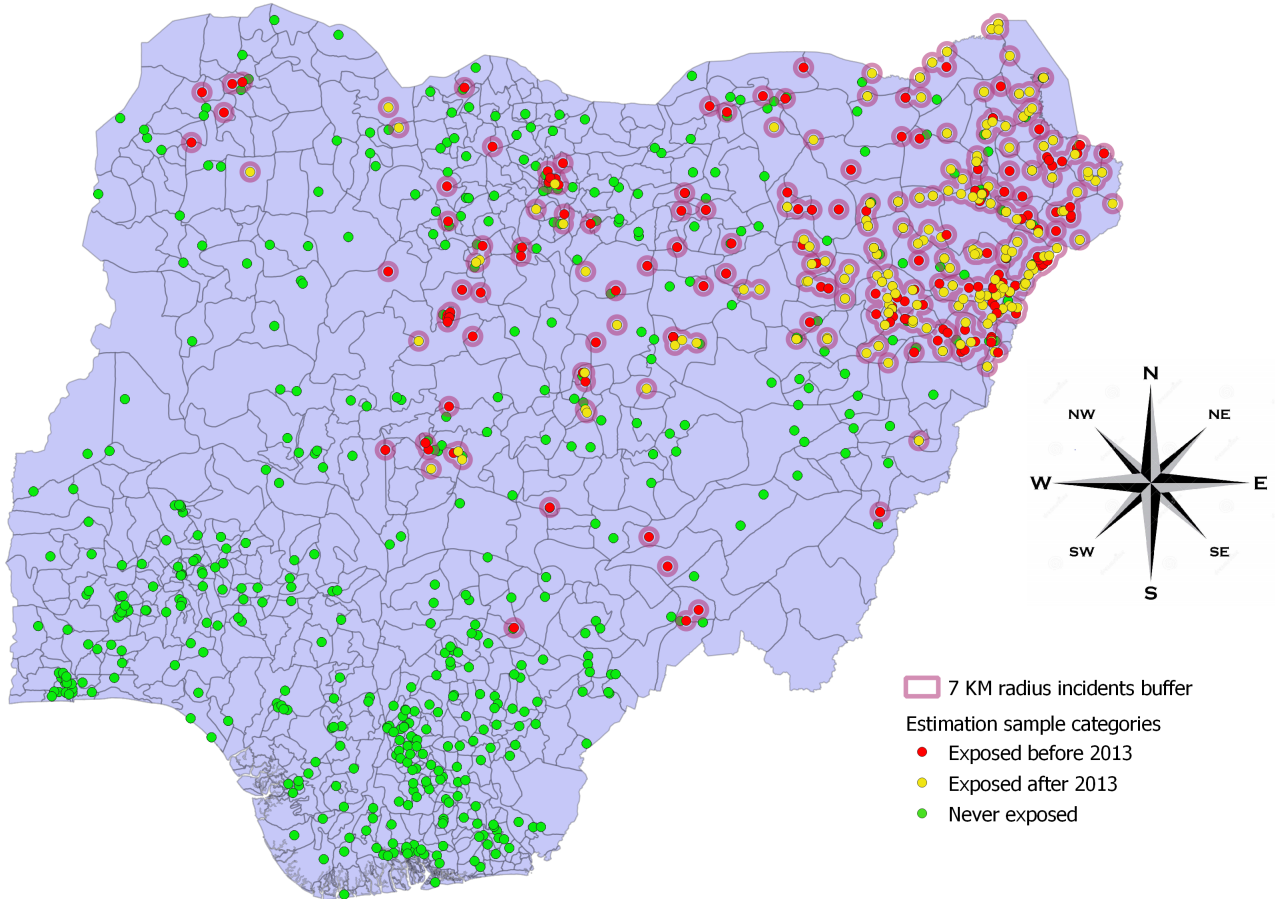
the three waves are August 2010/April 2011 (first wave), September 2012/April 2013 (second wave), and August 2015/May 2016 (third wave). In addition, the data is accompanied by location longitudes and latitudes which might be used to merge the data with other geo-referenced data sources such as the armed conflicts location and events database (ACLED)([Raleigh, 2010](#)). Using string search within the ACLED database, conflict event data involving the Boko Haram in Nigeria are selected, and spatially merged with the LSMS households. This allows the conduct of spatial proximity analysis that determines the spatial distance in kilometres (KM) of households location from dated conflict events.

In partitioning the households into exposed and non exposed households, the former must live within a distance close to any Boko Haram battle involving at least one fatality. However, the distance should be such that not all the households are considered as exposed at a given period. Two buffers of radii 5KM and 7KM are created around each conflict event based on distance bands already established for this conflict([see Bertoni et al., 2018](#)).² Only the households residing within any of these buffers are included in the estimation sample. Restricting the main estimations to waves 1 & 2, the dichotomy of exposed and control groups is determined by time of exposure as follows; the households that are exposed to events occurring during the time interval between waves 1 & 2 are designated as exposed group, while the rest exposed to events occurring between waves 2 & 3 are the control group.³ Under this restriction, the control group is strictly exposed between waves 2 & 3, whereas the exposed group is allowed to include certain households that were exposed consecutively in the two periods. See the samples distribution in figure 2. Finally, and in furtherance to limiting endogenous conflict exposure bias, households that were never exposed to the conflict under the above restrictions are not part of any of the estimations. Throughout the paper, the first data collection wave (August 2010/April 2011)is designated as the baseline, given that no effective exposure to the conflict took place during the period.

²Buffers above 7KM do not give room to separate the exposed and control groups, because then nearly all the relevant data points fall within the buffer at any given event-date combination

³Note that households in this second group will be exposed in the future but remain unexposed as at the time of the estimations

Figure 2: Timing of village exposure to conflict as classification of treatment status in estimation



3.2 Description of main non-conflict variables

3.2.1 Food security and controls

Three main food security measures are considered in this paper: the coping strategy index (CSI), the food consumption score (FCS), and the share of food consumption expenditure in total household expenditure per capita. While the CSI captures the behavioural and food utilization aspect of food insecurity (Maxwell, 1996; Maxwell et al., 1999), the share of food expenditure captures access to food through household purchasing ability (Meglar-Quinonez et al., 2006) and the FCS captures food availability through the diversity of household nutritional intake (Lovon and Mathiassen, 2014). Except for the FCS which is conversely distributed, higher values of the measures indicate higher food insecurity.

Having utilized other household heterogeneities in the computation of households resilience capacity, the control variables are selected to reflect mainly the structural characteristics of the households including age, gender, schooling, occupation of household head, and size, proportion of children in the household. Table 1 summarises the baseline control variables for all the estimations, and compares them across exposure status. The household heads in the exposed group are slightly younger and are more likely to be in polygamous marriage, otherwise the control variables are balanced across the exposure divide. This in line with the objective of the data selection strategy shows that the households are quite comparable in the absence of the conflict exposure, and lends credence to the identification strategy.

The relevant food security measures are computed as follows:

$$FS_{it} = \sum_{i=1}^n f_{it} * w$$

FS_{it} stands for both CSI and FCS. For the CSI, f_{it} represents frequency of coping strategy based on the number of days in the past 7 days that such strategies were used and w represents weights based on the severity of the strategy (WFP, 2009; Maxwell, 1996). For the FCS, f_{it} represents the number of standard food classes that the household consumed during the past 7 days, and w represents weights based on the micro-nutrients contents of the food classes (WFP, 2006).⁴ The food share is calculated as the weekly per capita household food expenditure divided by the total weekly expenditure per capita.

3.2.2 Computing Resilience Capacity

From the works of the Technical Working Group on Resilience Measurement (TWGRM), the resilience index measurement and analysis framework is produced (Smith and Frankenberger, 2017). This framework facilitates formal analysis and quantitative computation of resilience as well as its application to the evaluation of effects of shocks on households economic welfare. Using this framework, this study measures resilience as a latent index arising from multi-facet pillars comprising access to basic services (ABS), assets ownership (AST), adaptive capacity (AC), and social safety nets (SSN) (Bruck et al., 2019). The TWGRM established that resilience capacity derives from a set of conditions, attributes, or skills that enable households to achieve resilience in the face of shocks. These conditions are grouped into pillars of resilience and each pillar is constructed with contributions from a number of variables,

⁴The food classes include; staples, pulses, vegetables, fruits, animal products, sugar, diaries, fats and oil, and the micro-nutrients weights obtained from the West African food composition table (Barbara et al., 2012)

Table 1: Summary statistics for the control variables at baseline by household exposure status

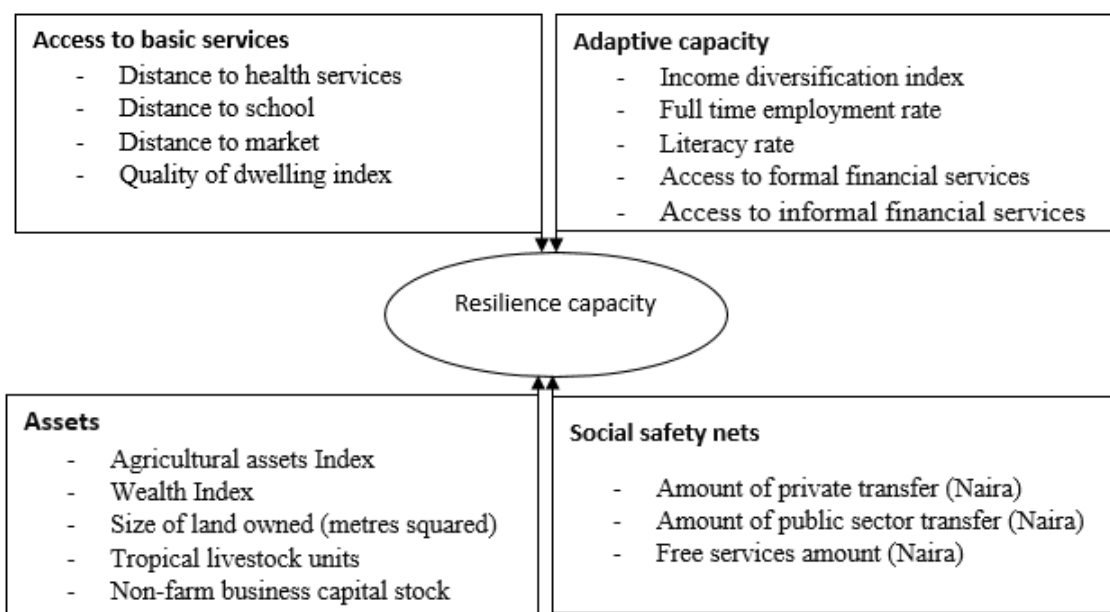
| Panel A: 5KM radius exposure | | | | | | | | | | |
|------------------------------|---------------|-------|-------|---------------------|-------|-------|----------------------|-------|-------|--------|
| Variable | pooled sample | | | Conflict (Pre-2013) | | | Conflict (Post-2013) | | | t-test |
| | obs | Mean | Sd | obs | Mean | Sd | obs | Mean | Sd | |
| Urban | 1, 374 | 0.17 | 0.37 | 986 | 0.15 | 0.36 | 388 | 0.24 | 0.43 | -0.09 |
| Age of HH head | 1, 374 | 47.68 | 15.25 | 986 | 48.10 | 15.59 | 388 | 47.05 | 14.33 | 1.05* |
| HH head is wage_worker | 1, 374 | 0.41 | 0.28 | 986 | 0.52 | 0.27 | 388 | 0.48 | 0.32 | 0.04 |
| HH is agricultural worker | 1, 374 | 0.68 | 0.14 | 986 | 0.66 | 0.14 | 388 | 0.74 | 0.17 | -0.08 |
| Household size | 1, 374 | 6.58 | 3.37 | 986 | 6.29 | 3.06 | 388 | 7.16 | 4.07 | -0.87 |
| Female HH head | 1, 577 | 0.07 | 0.25 | 986 | 0.08 | 0.27 | 388 | 0.04 | 0.20 | 0.04 |
| HH head is literate | 1, 374 | 0.51 | 0.50 | 986 | 0.51 | 0.50 | 388 | 0.50 | 0.50 | 0.02 |
| Ratio of children | 1, 374 | 0.36 | 0.23 | 986 | 0.35 | 0.23 | 388 | 0.37 | 0.23 | -0.02 |
| HH head marital status | | | | | | | | | | |
| Never married | 1, 374 | 0.02 | 0.15 | 986 | 0.02 | 0.15 | 388 | 0.04 | 0.19 | -0.02 |
| Monogamous marriage | 1, 374 | 0.61 | 0.49 | 986 | 0.62 | 0.48 | 388 | 0.57 | 0.50 | 0.05 |
| Polygamous marriage | 1, 374 | 0.28 | 0.45 | 986 | 0.25 | 0.43 | 388 | 0.35 | 0.48 | -0.10* |

| Panel B: 7KM radius exposure | | | | | | | | | | | |
|------------------------------|-------|---------------|-------|--|---------------------|-------|-------|----------------------|-------|-------|--------|
| Variable | obs | pooled sample | | | Conflict (Pre-2013) | | | Conflict (Post-2013) | | | t-test |
| | | Mean | Sd | | obs | Mean | Sd | obs | Mean | Sd | |
| Urban | 1,500 | 0.17 | 0.37 | | 1,062 | 0.17 | 0.35 | 438 | 0.22 | 0.42 | -0.06 |
| Age of HH head | 1,500 | 47.68 | 15.25 | | 1,062 | 49.98 | 15.53 | 438 | 46.89 | 14.45 | 3.09* |
| HH head is wage worker | 1,500 | 0.41 | 0.28 | | 1,062 | 0.53 | 0.27 | 438 | 0.48 | 0.32 | 0.06 |
| HH is agricultural worker | 1,500 | 0.68 | 0.14 | | 1,062 | 0.72 | 0.14 | 438 | 0.68 | 0.15 | 0.04 |
| Household size | 1,500 | 6.58 | 3.37 | | 1,062 | 6.30 | 3.04 | 438 | 7.34 | 4.04 | -1.05 |
| Female HH head | 1,500 | 0.07 | 0.25 | | 1,062 | 0.08 | 0.27 | 438 | 0.04 | 0.19 | 0.04 |
| HH head is literate | 1,500 | 0.51 | 0.50 | | 1,062 | 0.52 | 0.50 | 438 | 0.49 | 0.50 | 0.03 |
| Ratio of children | 1,500 | 0.36 | 0.23 | | 1,062 | 0.35 | 0.23 | 438 | 0.38 | 0.22 | -0.02 |
| HH head marital status | | | | | | | | | | | |
| Never married | 1,500 | 0.02 | 0.15 | | 1,062 | 0.02 | 0.14 | 438 | 0.03 | 0.18 | -0.01 |
| Monogamous marriage | 1,500 | 0.61 | 0.49 | | 1,062 | 0.63 | 0.48 | 438 | 0.57 | 0.50 | 0.06 |
| Polygamous marriage | 1,500 | 0.28 | 0.45 | | 1,062 | 0.27 | 0.43 | 438 | 0.35 | 0.48 | -0.08* |

Notes: Sample sizes are sensitive to radii of conflict exposure measured in space; Treatment denotes treatment group comprising households that were not exposed to conflict during first data collection wave (August 2010/April 2011), but exposed to the conflict before or during the second data collection wave (September 2012/April 2013). On the other hand, Control denotes control group comprising households that were not exposed to conflict during first data collection wave (September 2012/April 2013), but exposed to the conflict before or during the third data collection wave (August 2015/May 2016). The relevant periods for the main estimations in the subsequent sections are the data collection waves 1 and 2, only. t-test column refers to mean differences between the treatment and control groups. *** p<0.01, ** p<0.05, * p<0.1.

the comprehensive list of which is rarely found in any single data source. In this study, the pillars are computed from variables selected from the Living Standard Measurement Survey (LSMS) based on the selection theories discussed in [Bene et al, \(2016\)](#).

Figure 3: Indicators of resilience capacity and pillars



The overall resilience capacity index is measured using a two-step factor analysis procedure as outlined in [d'Errico et al. \(2018\)](#). The four latent pillars of resilience capacity are first estimated on the basis of observed variables and then combined to estimate the resilience capacity index under the factors analysis framework. Figure 3 shows the main factors used for the computations. In each step, the factor variables are retained only if they explain up 95 percent of the endogenous variables. In the final step, the most important factors contributing to the index are adaptive capacity, access to basic services, assets and social safety nets, respectively. In the appendix, tables 9 and 10 present the definitions and the summary statistics for the observed factor variables used in the first step of the computation, while table 11 shows the factor loadings. This process is repeated over the time and the computed indices are compared across periods and exposure status in table 2 along with the food security outcomes.

Table 2: Summary statistics of the food security and resilience capacity outcomes by Time and treatment status

| Variable | Pooled sample | | | Treatment | | | Control | | | t-test of means |
|------------|---------------|-------|-------|-----------|-------|-------|---------|-------|-------|-----------------|
| | obs | mean | sd. | obs | Mean | Sd. | obs | Mean | Sd. | |
| Time = 0 | | | | | | | | | | |
| CSI | 1,500 | 1.80 | 5.55 | 1,062 | 2.15 | 6.32 | 438 | 1.90 | 2.64 | 0.26 |
| Food ratio | 1,500 | 0.77 | 0.17 | 1,062 | 0.78 | 0.17 | 438 | 0.75 | 0.17 | 0.03 |
| FCS | 1,500 | 53.06 | 21.88 | 1,062 | 52.71 | 22.99 | 438 | 54.50 | 18.16 | -1.79* |
| RCI | 1,500 | 0.23 | 0.15 | 1,062 | 0.22 | 0.15 | 438 | 0.24 | 0.15 | -0.02 |
| ABS | 1,500 | 0.20 | 0.05 | 1,062 | 0.20 | 0.05 | 438 | 0.21 | 0.05 | -0.01 |
| AC | 1,500 | 0.20 | 0.05 | 1,062 | 0.21 | 0.05 | 438 | 0.20 | 0.05 | -0.01 |
| SSN | 1,500 | 0.34 | 0.18 | 1,062 | 0.33 | 0.17 | 438 | 0.37 | 0.18 | -0.01* |
| ASSETS | 1,500 | 0.83 | 0.12 | 1,062 | 0.83 | 0.12 | 438 | 0.82 | 0.13 | 0.01* |
| Time = 1 | | | | | | | | | | |
| CSI | 1,500 | 3.88 | 8.41 | 1,062 | 4.67 | 9.46 | 438 | 1.78 | 4.70 | 2.89*** |
| Food ratio | 1,500 | 0.80 | 0.22 | 1,062 | 0.83 | 0.23 | 438 | 0.73 | 0.13 | 0.10*** |
| FCS | 1,500 | 53.35 | 23.46 | 1,062 | 52.54 | 23.25 | 438 | 57.10 | 23.38 | -4.56*** |
| RCI | 1,500 | 0.21 | 0.14 | 1,062 | 0.20 | 0.13 | 438 | 0.27 | 0.17 | -0.07** |
| ABS | 1,500 | 0.19 | 0.05 | 1,062 | 0.18 | 0.05 | 438 | 0.19 | 0.05 | -0.01*** |
| AC | 1,500 | 0.19 | 0.05 | 1,062 | 0.16 | 0.05 | 438 | 0.21 | 0.05 | -0.06*** |
| SSN | 1,500 | 0.36 | 0.14 | 1,062 | 0.43 | 0.11 | 438 | 0.26 | 0.17 | 0.17*** |
| ASSETS | 1,500 | 0.81 | 0.11 | 1,062 | 0.80 | 0.11 | 438 | 0.81 | 0.11 | -0.01* |

Treatment denotes treatment group comprising households that were not exposed to conflict during first data collection wave (August 2010/April 2011), but exposed to the conflict before or during the second data collection wave (September 2012/April 2013). On the other hand, Control denotes control group comprising households that were not exposed to conflict during first data collection wave (September 2012/April 2013), but exposed to the conflict before or during the third data collection wave (August 2015/May 2016). The relevant periods for the main estimations in the subsequent sections are the data collection waves 1 and 2, only. CSI = Coping strategy index, Food ratio = share of per capita household food expenditure; FCS = Food consumption score, RCI = Resilience capacity index, ABS = Access to basic services; AC = Adaptive capacity; SSN = Social safety nets, Assets = Assets index. t-test refers to mean differences between the exposed and control groups. *** p<0.01, ** p<0.05, * p<0.1.

4 Estimation of the direct effects

4.1 The conflict and food (in)security: direct relationship

In the meantime, this section ignores the potential linkage between food security and resilience capacity and investigate the basic relationships between the Boko Haram conflict as a set of shocks and food insecurity as measures of household economic welfare. In effect, the section estimates the average effects of the conflict without accounting for the differentiation of the effects according to levels of household resilience capacity. The extension of these analyses in section 4.4 explores the conflict exposure's heterogeneous effects in respect of resilience capacity levels, which sheds light on the hypothesized roles of resilience capacity. Generally, the identification is based on the difference-in-differences (DID) estimator where the main outcomes are continuous variables FS_{it} denoting the various measures of food (in)security. The treatment variable $Conflict_i$ assumes two forms: when denoted as a dummy variable, $Conflict_i$ equals 1 if as at 2012/2013 period the household resides within any of the buffer zones earlier described, but as a partially continuous variable $Conflict_i$ equals the conflict intensity conventionally represented by the fatalities arising from the conflict. The non-parametric DID estimator α estimates the impact of exposure to the conflict on food security as specified in equation 1 below:

$$\alpha_{DID} = E[FS_i - FS_{i0} | Conflict = 1] - E[FS_{i1} - FS_{i0} | Conflict = 0] \quad (1)$$

In an experimental setup, it would be possible to obtain the exposure effect as difference in food security as households are made to take on/off the status of the exposed. However, in the present non-experimental case, only one of these potential outcomes can be observed since households cannot be exposed and not be exposed to the conflict at the same time. Given that the treatment and control groups of the study are eventually exposed to the conflict; one before and the other after the estimations data was collected, the sample approaches random assignment. Hence, the DID approach assumes that except for the conflict exposure, the treatment and control groups would have followed similar trends. Then, controlling for time invariant household characteristics, the differences in food (in)security between the exposed and not exposed households in the presence of the exposure is considered unbiased estimates of the average treatment effects of the conflict on the outcomes.⁵ The tests of mean differences by exposure status in Table 4 provides the bivariate approximation of these differ-

⁵A replica of this strategy is also applied to test if the conflict links with future vulnerability by decimating households endowments of resilience

ences. In nearly all the cases, the outcomes levels are significantly different between the pre-exposure ($Time = 0$) and post-exposure ($Time = 1$) periods suggesting the occurrence of trends discontinuities that likely arose from exposure to the conflict. Nevertheless, these may only be considered associative since the trend may be conflated with other time varying/invariant household characteristics. Hence the multivariate extensions include appropriate conditionings that narrow the sources of the remaining differences to the conflict exposure.

4.2 Econometric specifications

Drawing from the preceding discussions, this section estimates two multivariate econometric approximations of the DID model: The first multivariate regression is estimated for the levels of the outcomes in $Time = 1$ conditioning on baseline control variables including the baseline levels of the outcomes as a capture for the effects of differences in initial levels of the outcomes, whereas the second version is dynamic with household fixed effects capturing any time invariant household characteristics. These estimations are specified in equations 2 and 3 below:

$$FS_i = \delta + \rho Conflict_i + \gamma FS_{i0} + \beta X_{i0} + \phi V_l + \epsilon_i \quad (2)$$

Where FS_{i1} denotes the levels of food (in)security for household i measured at period $Time = 1$, $Conflict_i$ is a dummy variable indicating exposure to the conflict or the conflict intensity represented as the battle fatalities - which is equal to zero when the dichotomous $Conflict_i$ equals zero, and strictly positive when $Conflict_i$ equals one. FS_{i0} is the baseline level of food (in)security, X_{i0} is the baseline household characteristics, while ϵ_i is the idiosyncratic error term. If the adopted sample selection approaches randomness given the set of observable controls, equation 2 yields an unbiased estimate of the impact of exposure to the conflict on the outcomes ρ .

Otherwise, equation 2 needs to be adjusted to capture potential sources of bias relating unobserved household characteristics that are correlated with conflict exposure and household economic welfare - of which food (in)security is an indicator. For example, there may be certain enduring dietary preferences of the households that naturally influence the diversity of their consumption and scores on certain measures of food (in)security. Therefore the next of version of the estimations brings the consideration of these unobserved factors into the analyses by estimating the DID specification with household fixed effects within a panel data framework as follows:

$$FS_{it} = \tau_t + \theta_i + \alpha Conflict_i \times Time_t + \epsilon_{it} \quad (3)$$

where τ_t is a time fixed effect, θ_i is a set of household fixed effects, α is the *DiD* parameter obtained through the interaction of $Conflict_i$ and the post exposure period ($Time = 1$), while other parameters and variables maintain their previous definitions. The fixed effect model improves on the estimation of equation 3 by additionally controlling for unobserved time invariant household characteristics that may be correlated with exposure and economic welfare.

4.3 Estimates of direct effects

Using the various measure of the conflict exposure, the application of equations 2 and 3 yields the results reported in table 3. Panel A of table 3 reports estimates of the direct effects of the conflict exposure $Conflict_i$ denoted as a dummy variable, whereas Panel B reports direct effects of the conflict intensity. In panel A, the estimates indicate significant negative effects of the conflicts on the various indicators of food (in)security. Estimates in Panel A; columns 1, 2 and 3 derive from equation 2 estimated without household fixed effects, and indicate that exposure is associated with an increase of about 1.29 points in the coping strategy index, about 7.2 percent increase in the food expenditure share (food ratio) and no significant effect on food consumption score (FCS). The fixed effects DID estimates reported in Panel A; columns 4, 5 and 6 are prescriptively similar to the previously discussed estimates. Mostly, estimates regarding the FCS are insignificant, whereas those of the CSI and Food ratio increased by 1.24 points and 8.6 percent, respectively. In magnitude, the increase in the CSI and food ratio constitute 69 percent and 11 percentage points of their respective pre-exposure pooled means. Similarly, most of the outcomes respond strongly to the conflict intensity as shown in Panel B. Based on the DID fixed effects estimations in columns 4, 5 and 6, a 100 units increase in fatalities increases the CSI by 2.3 points and the food ratio by 7.5 percent, but there is no effect on the FCS. However, under the estimations without fixed effects, a 100 units increase in fatalities is associated with about 12 points decrease in FCS. Among the indicators of food security, dietary diversity or quality is most rooted in habits and culture that do not easily change, except under intensive shocks (Maxwell, 1999; Thiele and Weiss, 2003; Rozin, 2005). This is plausibly a factor behind the rather mild responsiveness of the FCS to this particular treatment. Generally, the model without the fixed effects seems to consistently overestimate the relevant effects as unaccounted fixed effects induce positive bias

in the estimates. Hence, the preference for the fixed effects model. Finally, in columns 1, 2 and 3, the initial values of the outcomes positively predict the current values as expected.

Table 3: Effect of conflict exposure on food (in)security

| A: Conflict exposure within 7KM | | | | | | |
|---|---------------------|-----------------------|---------------------|---------------------|-----------------------|---------------------|
| VARIABLES | (1) CSI | (2) FCS | (3) Food ratio | (4) CSI | (5) FCS | (6) Food ratio |
| <i>Conflict × Time</i> | 1.287*** (0.257) | -1.384 (0.858) | 0.072*** (0.008) | 1.240** (0.502) | -1.942 (1.566) | 0.086*** (0.015) |
| Baseline CSI | 0.884*** (0.027) | | | | | |
| Baseline FCS | | 0.343*** (0.014) | | | | |
| Baseline food ratio | | | 0.103*** (0.010) | | | |
| Baseline controls | yes | yes | yes | No | No | No |
| Household fixed effect | No | No | No | yes | yes | yes |
| Constant | 1.277* (0.691) | 41.070*** (2.318) | 0.721*** (0.021) | 12.962** (5.527) | 53.421*** (16.401) | 1.297*** (0.151) |
| Observations | | | | 3,000 | 3,000 | 3,000 |
| Number of households | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |
| B: Conflict intensity (no. of fatalities) | | | | | | |
| Conflict intensity (100s of fatalities) | 3.394*** (0.561) | -12.232*** (1.891) | 0.204*** (0.062) | 2.281*** (0.561) | -0.456 (1.930) | 0.075*** (0.006) |
| Baseline CSI | 0.951*** (0.026) | | | | | |
| Baseline FCS | | 0.471*** (0.017) | | | | |
| Baseline Food ratio | | | 0.281*** (0.013) | | | |
| Constant | 0.226 (0.664) | 31.665*** (2.263) | 0.623*** (0.021) | 8.778*** (2.502) | 27.734*** (7.424) | 0.872*** (0.069) |
| Baseline controls | yes | yes | yes | No | No | No |
| Household fixed effects | No | No | No | yes | yes | yes |
| Observations | | | | 3,000 | 3,000 | 3,000 |
| Number of households | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |

Notes: CSI = Coping strategy index, FCS = food consumption score; Food ratio = Share of household per capita food expenditure; Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

4.4 The role of resilience capacity

In this this, the theoretical position that the endowment of resilience capacity protects households welfare while the households experience shocks is investigated. Given that resilience might be endogenous to conflict exposure, pre-exposure resilience is used to generate the interest variables for the objective

of this sub section.⁶ Specifically, the pooled estimation sample is partitioned and designated as low and high resilience capacity groups of households according to whether baseline resilience capacity was below or above the resilience of the median household. Thereafter, the following equation is estimated:

$$FS_{it} = \tau_t + \theta_i + \alpha Conflict_i \times Time_t + \eta Conflict_i \times Highres_{i0} \times Time_t + \epsilon_{it} \quad (4)$$

Where $HighRes_{i0}$ is a dummy variable indicator of whether the resilience capacity of the household at baseline is greater than the median resilience among the pool of households. The $HighRes_{i0}$ is computed from the overall resilience index and the indices of the four pillars, and included in equation 4, one at a time. Other variables and parameters in the equation remain as described in the previous equations. The interest parameter in this equation is η which captures the conflict effect differential on households of high resilience capacity compared to households of low resilience capacity.

The results of estimating equation 4 is reported in table 4 which indicates that resilience indeed attenuates the negative effects of shocks on food security. The results in this table suggest that the results reported in table 3 hide significant discrepancies in the effect of the conflict with respect to the levels of households' initial resilience capacity. In general, households of low level of resilience are affected more severely by the conflict than households of high resilience capacity. In effect, while the effect of the conflict on the outcome of food consumption score (FCS) as reported in table 3 is insignificant, table 4 shows that households of high overall resilience capacity seem to have gained in food security. Specifically, measured as $\alpha + \eta$, high overall resilience capacity is associated with a gain of about 4 FCS points, high social safety nets (SSN) with about 3 FCS points, and high assets with half an FCS point. On the other dimensions of food security, high levels of the various pillars of resilience capacity similarly attenuates the effect of the conflict exposure. Comparatively, the resilience pillar of social safety nets (SSN) is the most influential in attenuating shocks by magnitude and spread across the food (in)security dimensions. Existing literature widely supports these findings, where most of the studies demonstrate that social safety nets is an important pool of resources for the mitigation of diverse types of shocks in conjunction with the other pillars of resilience such as access to basic services and adaptive capacity (Smith and Frankenberger, 2018; Bruck et al., 2019; d'Errico et al., 2018).

⁶This is also theoretically meaningful in the sense that pre-shock resilience resources provide the basis of households' coping strategies during shocks (Alinovi et al., 2010)

Table 4: Impact of baseline resilience levels on the food security during exposure to the conflict

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) |
|------------------------------------|---------------------|---------------------|---------------------|----------------------|---------------------|----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------------------|---------------------|
| | CSI | CSI | CSI | CSI | CSI | FCS | FCS | FCS | FCS | FCS | Food ratio | Food ratio | Food ratio | Food ratio | Food ratio |
| <i>Conflict × Time</i> | 1.386*** (0.527) | 1.625*** (0.540) | 1.052* (0.547) | 2.064*** (0.535) | 1.211** (0.534) | -5.394*** (1.656) | -2.946* (1.693) | -1.500 (1.715) | -0.687 (1.684) | -3.991** (1.680) | 0.079*** (0.015) | 0.081*** (0.016) | 0.078*** (0.016) | 0.071*** (0.016) | 0.078*** (0.016) |
| <i>HighRCI × Conflict × Time</i> | -0.380 (0.431) | | | | | 9.119*** (1.353) | | | | | 0.016 (0.012) | | | | |
| <i>HighABS × Conflict × Time</i> | | -0.788* (0.417) | | | | | 2.000 (1.315) | | | | | 0.007 (0.012) | | | |
| <i>HighAC × Conflict × Time</i> | | | 0.365 (0.418) | | | | | -0.914 (1.316) | | | | | 0.013 (0.012) | | |
| <i>HighSSN × Conflict × Time</i> | | | | -1.783*** (0.417) | | | | | 2.808** (1.319) | | | | | -0.030*** (0.012) | |
| <i>HighAsset × Conflict × Time</i> | | | | | 0.0739 (0.420) | | | | | 4.579*** (1.324) | | | | | 0.017 (0.012) |
| Household FE ? | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 1.030*** (0.357) | 1.030*** (0.357) | 1.030*** (0.357) | 1.030*** (0.357) | 1.030*** (0.357) | 54.50*** (1.121) | 54.50*** (1.132) | 54.50*** (1.133) | 54.50*** (1.131) | 54.50*** (1.129) | 0.747*** (0.010) | 0.747*** (0.009) | 0.747*** (0.009) | 0.747*** (0.009) | 0.747*** (0.009) |
| Observations | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| Number of households | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |

Notes: RCI = Resilience capacity index, ABS = index of Access to basic services, AC = index of adaptive capacity, SSN = Index of social safety nets; Asset = Index of household assets; CSI = Coping strategy index, FCS = food consumption score; Food ratio = Share of household per capita food expenditure; Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

5 Potential medium to long term effects

5.1 Conflict exposure and the household resilience capacity

In the preceding section, the importance of resilience capacity in protecting household welfare is acknowledged. However, civil conflicts are predicted to damage the main elements of resilience capacity such as public infrastructures and household economic assets (Minoiu and Shemyakina, 2014). In effect, this is the critical channel that links short-run conflict damages to long-run consequences linked to the widely acknowledged vulnerability trap (Bene et al., 2016). This section aims to investigate whether the Boko Haram conflict has any impact on the resilience capacity and by so doing anticipate the long-run consequence of the conflict. The econometric estimations follow DID model developed in section 4.2 and replicated in equation 5 below:

$$RC_{it} = \tau_t + \theta_i + \alpha Conflict_i \times Time_t + \epsilon_{it} \quad (5)$$

All variables and parameters remain as described in section 4.2, except that the outcome variable RC_{it} stands for the overall resilience index (RCI) and its various pillars including access to basic services (ABS), social safety nets (SSN), adaptive capacity (AC) and Assets (ASSET).

Table 5: Effects of conflict exposure on resilience capacity

| VARIABLES | (1) RCI | (2) RCI | (3) ABS | (4) ABS | (5) SSN | (6) SSN | (7) AC | (8) AC | (9) ASSET | (10) ASSET |
|-------------------------------|---------------------|----------------------|---------------------|----------------------|---------------------|---------------------|---------------------|----------------------|---------------------|----------------------|
| <i>Conflict</i> × <i>Time</i> | -0.097** (0.044) | | -0.065** (0.032) | | 0.190*** (0.063) | | -0.076** (0.031) | | -0.107 (0.077) | |
| <i>fatalities</i> × 100 | | -0.137*** (0.021) | | -0.104*** (0.021) | | 1.653** (0.792) | | -0.251*** (0.038) | | -0.222*** (0.046) |
| Household FE ? | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Constant | 1.559*** (0.189) | 1.593*** (0.180) | 1.675*** (0.059) | 1.625*** (0.056) | 4.211*** (0.203) | 3.782*** (0.196) | 1.559*** (0.067) | 1.559*** (0.064) | 7.914*** (0.149) | 7.881*** (0.140) |
| Observations | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| Households | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |

Notes: RCI = Resilience capacity index, ABS = index of Access to basic services, AC = index of adaptive capacity, SSN = Index of social safety nets; Asset = Index of household assets
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The results reported in table 5 shows that the exposure to the conflict is associated with negative and significant impacts on the overall resilience index and most of its pillars, except the social safety nets. By the results, overall resilience (RCI) declined by 0.097 points which about 42 percent of the pre-exposure mean RCI. Access to basic services (ABS) declined by 0.065 points (32 percent of pre-exposure

mean), adaptive capacity (AC) declined by 0.076 points (40 percent of pre-exposure mean). Regarding the assets index (ASSETS), the index not significantly respond to general conflict exposure, but is reduced by 0.2 (about 27 percent of pre-exposure pooled mean) for every 100 fatalities. This makes sense from the standpoint of the Boko Haram being Guerrilla rather than full-blown war. Therefore, battles need to be sufficiently intense such as during confrontations with state forces for assets to be severely destroyed. Otherwise, kidnappings, thefts and scaremongering are the main strategies of the Boko Haram (Falode, 2016). As Expected, the index of social safety nets (SSN) increased over the exposure in line with the findings most previous studies(see; Bruck et al., 2019). The average impact of the exposure on SSN is 0.19 points, amounting to about 56 percent of the pre-exposure mean. Nevertheless, related previous studies regard social safety nets as temporary relief given as it is composed mainly of migrant remittances and humanitarian aids that are driven by altruism. As a result, such resources may not support household long-term shocks mitigation strategies. In the light of this, the effect of the exposure is conclusively negative suggesting that the Boko Haram conflict has negative short- and medium or long-run consequences.

6 Robustness checks

Results in the preceding sections established rather strong negative effects of the conflict, directly on food security but attenuated through the resilience capacity. The conflict also produced potential long-term effects through the reduction of the level of household resilience capacity. However, these effects are obtained conditional on the controls for observable characteristics, and the study sample restriction strategy which assumes a balanced distribution of unobservable characteristics (potential confounders) between the treated and control groups. This section tests the robustness of these results by relaxing some of the critical assumptions of the previous estimations, particularly relating to selection bias and sample attrition.

6.1 Selection into conflict exposure

Although the determination of exposure and control groups by means of realised and future exposure to the conflict strongly suggests balance in treatment confounders, there remains some chance that time varying confounders unrelated to the conflict might disrupt the parallel trend assumption and bias the estimations. In this subsection, I pursue a test of any indication of this that might have started

during the pre-treatment period. Following the sample restriction adopted in the study, I estimate the probability of being included in the exposure group based on baseline control characteristics. The probability is specified as follows:

$$Conflict_{i1} = \alpha + X'_{i0}\delta + \theta_c + \varepsilon_i \quad (6)$$

where $Conflict_{i1}$ is a dummy variable which takes value 1 if $household_i$ living in community c is included in the exposure group (5km or 7km buffer), and zero otherwise. $X'_{i0}\delta$ is a vector of household and household head characteristics used as controls in the previous estimations, and ε_{ijs} is the error term. On the premise that certain community characteristics are important determinants of conflict onset, θ_c is included in the selection model. θ_c denotes a vector of community dummy variables, where the survey enumeration areas are used as proxies for communities despite a bit geographically larger than communities. One enumeration area may include 1 - 2 communities in the context of Nigeria (NBS, 2013). The main variables are indexed according to the data period in which they are measured: Index 1 indicates the wave 2 (September 2012/April 2013) period in which $Conflict_{i1}$ is measured, while index 0 indicates the the baseline period in which X_{i0} is measured.

Table 6 reports the probit selection into conflict exposure estimations. Clearly, exposure is not selective on the observed control variables. In addition, indicators of resilience capacity are included in order to further assess the randomness of exposure even in this dimension. The results only implicated the social safety nets (SSN) dimension of resilience capacity which is more favourable to the exposure group at the baseline. Although this must be borne in mind when interpreting the main results, this singular base line imbalance should not violet the assumption of randomness of the exposure based on the sample restriction and this is even more so when household fixed effects are part of the estimations. All other dimensions are balanced between the two groups given the controls.

6.2 Sample attrition

The estimation panel data for this study is reputed for low attrition rate. The data description report estimates that reinterview rate is nearly 96% wave-on-wave for the first three waves (Osabohien, 2018). Despite this, concerns for attrition is not completely eliminated given that the variable of interest in this study is exposure to conflict that is known to have caused massive deaths and forced displacements. In this section, the paper conducts attrition falsification test to confirm that attrition bias does not bias

the estimates. Defined as missing households during the wave 2 data collection, attrition is estimated as a function of the conflict exposure. The estimation equation is specified below:

$$Attrition_i = \alpha + X'_{i0}\delta + \theta_c + \varepsilon_i \quad (7)$$

where $Attrition_i$ is the attrition dummy variable, and other variables and parameters remain as defined previously.

Shown in table 7, attrition is related to neither conflict exposure, nor the control variables, which raises confidence on the main estimates. Nevertheless, the levels of resilience is weakly correlated with attrition: access to basic services (ABS) and adaptive capacity (AC) return with negative coefficients that are only significant at the 10 percent level. If households of low resilience capacity in their baseline communities disintegrate or migrate upon exposure to the conflict, it further highlights the shocks absorbing roles of resilience identified in the main estimations. Empirically, this type of attrition bias may only work to attenuate the estimated roles of resilience. Therefore, the estimates as far as the roles of resilience are concerned may be considered the lower bounds of their actual levels.

6.3 Alternative measure of exposure

In order to partition the sample into exposed and control households, the paper creates a series of buffers around any conflict event some of which proves too large to allow the separation of the two groups of households. The largest radius that allows reasonable separation is around the 7KM radius which makes it the reference radius of exposure for the study (see figure 2). Nevertheless, in this section, the alternative buffer (5KM radius) which is 2KM less than the reference is used. All the previous estimations were repeated under the new exposure measure, and the new sets of estimations mirror the former. However, in some cases, coefficients appear stronger but they are never statistically different from their previous equivalents. The estimated baseline estimation on food security is reported in table 8 below, while the rest of the results are retained by the author in order to conserve space. The remaining results are available from the author on demand.

7 Conclusion and policy recommendations

Using three main indicators of food (in)security; the coping strategy index (CSI), share of food expenditure per capita (Food ratio) and the food consumption score (FCS), this paper demonstrates

that exposure to the Boko Haram conflict causes the households to move down the ladder of food security. The overall effects of the conflict are substantial and negative on all the dimensions of food security. However, these overall effects hide substantial heterogeneities across levels of resilience capacity. Further analyses explore these heterogeneities by including dichotomous high and low levels of resilience capacity in models of triple interactions of resilience, conflict exposure and time. These models yield unambiguous prediction that resilience protects household welfare during conflict shocks, thereby confirming the central theory of resilience as a place holder for household welfare. Although the resilience pillar of social safety nets (SSN) dominates the other pillars in magnitudes and spread across the dimensions of food security, all the pillars of resilience contribute to the shocks mitigation.

The paper anticipates that the nature of violent conflict generates a potential channel of poverty and vulnerability trap. This idea is investigated and confirmed in this particular case based on the effects on resilience capacity. It is estimated that the conflict reduced the overall resilience capacity by 42 percent, access to basic services by 32 percent, and adaptive capacity by 40 percent, and the effects on the assets index are only induced by highly intensive conflicts. In contrast, the index of social safety nets (SSN) increased in line with theoretical expectation. The increase in SSN reflects all the humanitarian aids from donor agencies and private individuals provoked by the need to cushion the conflict induced sufferings. In all, this study supports the ongoing arguments about the merits of resilience approach to development, which aims to enhance the ability of systems (households, communities, states) to withstand and recover from shocks. The study demonstrates that resilience is a cushion of shocks, but also susceptible to the same shocks. Therefore, resilience deserves to be an important consideration during post disasters interventions. While short term interventions such food and cash aids may curtail immediate and direct welfare losses, serial vulnerability may only be eliminated through interventions in rebuilding resilience. Advising on the specific projects for enhancing resilience is beyond the scope of this study. However, it is clear from this study that the enabling environment for resilience comprises public use services such as markets, roads, health facilities and other basic infrastructures that policy could easily target. To incorporate these in development, public policies in shocks prone regions need to be multi-sectoral and forward looking. The paper invites governments, inter-governmental, and non-governmental organisations to incorporate the enhancement of resilience in future intervention programmes.

The estimates reported in this paper are produced from painstakingly conducted identification strategy, and supported by relevant robustness checks. Therefore, the inferences made obtain from

judicious use of the available data. Nevertheless, the paper does not claim that the estimates are purely causal. In particular, it may be acknowledged that whereas the TWGRM guidelines on resilience measurement are followed in the paper, the constructed resilience may not capture the whole essence of the concept. Resilience is multifaceted and data driven, and its computation may be limited by data quality (see [Bruck et al., 2019](#); [Smith and Frankenberger, 2018](#); [d'Errico et al., 2018](#)). This limitation might limit the structural relationships that resilience represents. Thus, the paper invites the reader to interpret this aspect of the results cautiously.

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Table 6: Probit estimation of selection into conflict exposure

| VARIABLES | (1) Conflict | (2) Conflict | (3) Conflict | (4) Conflict | (5) Conflict |
|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Urban | -0.0014 (0.0088) | -0.0003 (0.0087) | 0.0101 (0.0091) | -0.0004 (0.0087) | -0.0006 (0.0087) |
| Age of HH head | -0.0000 (0.0001) | -0.0000 (0.0001) | -0.0000 (0.0001) | -0.0000 (0.0001) | -0.0000 (0.0001) |
| HH head is wage worker | -0.0032 (0.0061) | -0.0029 (0.0061) | -0.0033 (0.0061) | -0.0026 (0.0061) | -0.0033 (0.0061) |
| Household size | 0.0001 (0.0006) | 0.0002 (0.0006) | 0.0001 (0.0006) | 0.0004 (0.0006) | 0.0002 (0.0006) |
| Female head | 0.0022 (0.0073) | 0.0024 (0.0073) | 0.0028 (0.0073) | 0.0022 (0.0073) | 0.0025 (0.0073) |
| HH head is literate | 0.0026 (0.0039) | 0.0032 (0.0038) | 0.0035 (0.0038) | 0.0035 (0.0038) | 0.0029 (0.0038) |
| Ratio of children | 0.0037 (0.0094) | 0.0035 (0.0095) | 0.0036 (0.0094) | 0.0023 (0.0095) | 0.0034 (0.0094) |
| Head is never married | -0.0001 (0.0113) | -0.0004 (0.0113) | 0.0004 (0.0112) | -0.0004 (0.0113) | 0.0001 (0.0113) |
| RCI | 0.0011 (0.0014) | | | | |
| ABS | | 0.0005 (0.0042) | | | |
| SSN | | | 0.0196*** (0.0052) | | |
| AC | | | | -0.0032 (0.0045) | |
| ASSET | | | | | 0.0016 (0.0015) |
| Village Dummies | yes | yes | yes | yes | yes |
| Constant | 0.7012*** (0.0322) | 0.7205*** (0.0327) | 0.9746*** (0.0328) | 0.7080*** (0.0332) | 0.9904*** (0.0340) |
| Observations | 1,703 | 1,703 | 1,703 | 1,703 | 1,703 |
| Pseudo R2 | 0.4842 | 0.4842 | 0.4843 | 0.4842 | 0.4842 |

Notes: RCI = Resilience capacity index, ABS = Access to basic services
SSN = Social safety nets, AC = Adaptive capacity, ASSET = Assets index
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Probit estimation of sample attrition

| VARIABLES | (1) Attrition | (2) Attrition | (3) Attrition | (4) Attrition | (5) Attrition |
|--------------------------|------------------------|----------------------|-----------------------|----------------------|-----------------------|
| Conflict | -0.0005 (0.0544) | 0.0005 (0.0543) | 0.0047 (0.0546) | -0.0016 (0.0543) | 0.0020 (0.0544) |
| Urban | 0.0125 (0.0182) | 0.0148 (0.0180) | 0.0096 (0.0189) | 0.0141 (0.0180) | 0.0150 (0.0180) |
| Age of head | 0.0003 (0.0003) | 0.0003 (0.0003) | 0.0003 (0.0003) | 0.0003 (0.0003) | 0.0003 (0.0003) |
| HH head is a wage worker | 0.0045 (0.0128) | 0.0064 (0.0127) | 0.0054 (0.0127) | 0.0064 (0.0127) | 0.0063 (0.0127) |
| Household size | -0.0032*** (0.0012) | -0.0022* (0.0013) | -0.0031** (0.0012) | -0.0022* (0.0013) | -0.0030** (0.0012) |
| Female head | -0.0188 (0.0152) | -0.0192 (0.0152) | -0.0187 (0.0152) | -0.0193 (0.0152) | -0.0190 (0.0152) |
| HH head is literate | 0.0092 (0.0080) | 0.0118 (0.0079) | 0.0103 (0.0079) | 0.0118 (0.0079) | 0.0112 (0.0079) |
| Ratio of children | 0.0239 (0.0195) | 0.0179 (0.0197) | 0.0231 (0.0195) | 0.0179 (0.0197) | 0.0229 (0.0195) |
| HH head is never married | -0.0111 (0.0234) | -0.0119 (0.0234) | -0.0119 (0.0234) | -0.0119 (0.0234) | -0.0125 (0.0234) |
| RCI | 0.0020 (0.0030) | | | | |
| ABS | | -0.0161* (0.0087) | | | |
| SSN | | | -0.0090 (0.0109) | | |
| AC | | | | -0.0172* (0.0093) | |
| ASSET | | | | | -0.0036 (0.0031) |
| Constant | -0.0041 (0.0862) | 0.0189 (0.0869) | 0.0049 (0.0867) | 0.0302 (0.0879) | 0.0215 (0.0888) |
| Observations | 1,703 | 1,703 | 1,703 | 1,703 | 1,703 |
| Pseudo R2 | 0.3171 | 0.3173 | 0.3172 | 0.3173 | 0.3172 |

Notes: RCI = Resilience capacity index, ABS = Access to basic services
SSN = Social safety nets, AC = Adaptive capacity, ASSET = Assets index
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Food (in)security and conflict exposure at the 5km radius of exposure

| A: Conflict exposure within 5KM | | | | | | |
|---|---------------------|------------------------|---------------------|---------------------|-----------------------|---------------------|
| VARIABLES | (1) CSI | (2) FCS | (3) Food ratio | (4) CSI | (5) FCS | (6) Food ratio |
| <i>Conflict × Time</i> | 1.312*** (0.204) | -1.143 (0.858) | 0.075*** (0.010) | 1.262** (0.610) | -1.889 (1.616) | 0.088*** (0.017) |
| Baseline CSI | 0.893*** (0.031) | | | | | |
| Baseline FCS | | 0.347*** (0.012) | | | | |
| Baseline food ratio | | | 0.115*** (0.009) | | | |
| Baseline controls | yes | yes | yes | No | No | No |
| Household fixed effect | No | No | No | yes | yes | yes |
| Constant | 1.285* (0.691) | 45.142*** (2.318) | 0.813*** (0.021) | 10.652** (5.527) | 53.011*** (16.401) | 0.771*** (0.151) |
| Observations | | | | 2,766 | 2,766 | 2,766 |
| Number of households | 1,383 | 1,383 | 1,383 | 1,383 | 1,383 | 1,383 |
| B: Conflict intensity (no. of fatalities) | | | | | | |
| Conflict intensity (100s of fatalities) | 4.102*** (0.342) | - 14.311*** (0.210) | 0.323*** (0.010) | 2.317*** (0.224) | -0.307 (1.462) | 0.172*** (0.033) |
| Baseline CSI | 1.022*** (0.026) | | | | | |
| Baseline FCS | | 0.239*** (0.015) | | | | |
| Baseline Food ratio | | | 0.296*** (0.020) | | | |
| Constant | 0.365 (0.543) | 27.119*** (1.800) | 0.488*** (0.031) | 7.654*** (1.913) | 19.225*** (5.326) | 0.735*** (0.053) |
| Baseline controls | yes | yes | yes | No | No | No |
| Household fixed effects | No | No | No | yes | yes | yes |
| Observations | | | | 2,766 | 2,766 | 2,766 |
| Number of households | 1,383 | 1,383 | 1,383 | 1,383 | 1,383 | 1,383 |

Notes: CSI = Coping strategy index, FCS = food consumption score; Food ratio = Share of household per capita food expenditure; Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Definition of Pillars and Observed Predictors

| Variable | Definition/Description |
|---------------------------------------|--|
| Access to Basic Services (ABS) | measuring tendency to access basic welfare support services |
| Infrastructure index | Index of dwelling quality computed using principal component analysis based on the ownership of household items such as personal house, modern roof, non-dirty floor, running water, electricity. |
| KM to secondary school | distance |
| KM to primary school | distance |
| KM to health services | distance |
| KM to market | distance |
| Assets (AST) | measuring, inter alia, the tendency for consumption smoothening using owned assets |
| agricultural asset index | index of agricultural assets computed using principal component analysis based on the ownership of specific agricultural tools e.g hoe, plough, harrow, tractor harvesting and thrashing machines, reapers, water pumps, etc. |
| wealth index | index of non-productive assets computed using principal component analysis based on the ownership of specific household assets e.g telephone, fridge, furniture, lantern, computer, utensil, television, radio, lamp, mosquito nets, iron, stove, water-heater, stereo, books, antenna, motor vehicle, motorcycle and bicycle. |
| land owned | hectares of land owned per capita |
| Tropical livestock units | TLU is a weighted sum of the number of different livestock owned by the households. They are converted as follows: Camel 1, Cattle 0.7, donkey/mules/horses 0.55, sheep/goats 0.1, chicken 0.01. |
| Adaptive capacity (AC) | measuring, inter alia, the tendency to maintain welfare using human capital endowment |
| Income diversification | Principal component index with dummies for income from (1) agriculture and fishing wages; (2) non-agriculture wages; (3) farming production; (4) livestock and fishing production; (5) non-agriculture business; (6) transfers and (7) other income |
| Average education | Average years of education among household members |
| participation rate | Number of active household members divided by household size |
| Social Safety Nets (SSN) | measuring tendency to receive succour from family and other social networks |
| private transfer in naira | monthly amount received per capita |
| other transfer in naira | monthly amount received per capita |
| scholarship (yes or no) | Dummy variable |
| Has at least one migrant | Dummy variable |

Notes: Bold fonts = pillars; for all indices, higher values represent higher attribute

Table 10: Summary statistics for variables used to compute the resilience indices

| | Time = 0 | | | Time = 1 | | |
|------------------------------------|-----------|---------|---------|-----------|---------|---------|
| | Treatment | Control | diff. | Treatment | Control | diff. |
| RCI | 0.310 | 0.280 | 0.030 | 0.180 | 0.260 | -0.080 |
| ABS | 0.190 | 0.222 | -0.032 | 0.140 | 0.220 | -0.080 |
| Infrastructure index | -0.170 | -0.130 | -0.040 | -0.220 | -0.150 | -0.070 |
| Distance to primary school (km) | 19.740 | 20.220 | -0.480 | 28.310 | 21.440 | 6.870 |
| Distance to secondary school (km) | 32.020 | 42.050 | -10.030 | 37.020 | 40.110 | -3.090 |
| Distance from health services (km) | 34.160 | 43.760 | -9.600 | 51.190 | 44.170 | 7.020 |
| Distance to market (km) | 30.700 | 29.980 | 0.720 | 31.200 | 29.500 | 1.700 |
| Distance to major road (km) | 18.100 | 30.140 | -12.040 | 26.100 | 25.210 | 0.890 |
| AST | 0.210 | 0.189 | 0.021 | 0.150 | 0.260 | -0.110 |
| Pc agricultural assets | 0.240 | 0.170 | 0.070 | 0.080 | 0.190 | -0.110 |
| pc non -farm business assets | -0.010 | -0.030 | 0.020 | -0.060 | -0.020 | -0.040 |
| Pc wealth Index | 0.170 | 0.190 | -0.020 | 0.120 | 0.350 | -0.230 |
| Pc Tropical Livestock Unit | 0.380 | 0.270 | 0.110 | 0.210 | 0.290 | -0.080 |
| AC | 0.380 | 0.400 | -0.020 | 0.250 | 0.370 | -0.120 |
| Participation index | 0.560 | 0.450 | 0.110 | 0.360 | 0.490 | -0.130 |
| HH average years of education | 5.010 | 5.170 | -0.160 | 5.120 | 5.330 | -0.210 |
| Dependency ratio | 0.880 | 1.430 | -0.550 | 0.890 | 1.540 | -0.650 |
| diversity of income sources | 0.810 | 0.840 | -0.030 | 0.680 | 0.850 | -0.170 |
| SSN | 0.220 | 0.190 | 0.030 | 0.390 | 0.200 | 0.190 |
| transfers (naira) | 297.000 | 203.000 | 94.000 | 564.000 | 223.000 | 341.000 |
| other transfers (naira) | 205.000 | 186.000 | 19.000 | 880.000 | 156.000 | 724.000 |
| scholarship (yes or no) | 0.560 | 0.490 | 0.070 | 0.670 | 0.440 | 0.230 |
| Has a migrant (yes or no) | 0.290 | 0.300 | -0.010 | 0.570 | 0.260 | 0.310 |

notes: eigenvalues cut-off of 95 percent is used to admit variables into components

Table 11: Factor loadings for resilience capacity index and pillars

| | factor 1 | factor 2 | factor 3 | factor 4 | factor 5 | uniqueness |
|--|----------|----------|----------|----------|----------|------------|
| Resilience capacity index | | | | | | |
| AST | 0.67 | 0.22 | 0.26 | NA | NA | 0.95 |
| AC | 0.78 | -0.22 | 0.39 | NA | NA | 0.75 |
| SSN | 0.58 | 0.43 | 0.28 | NA | NA | 0.81 |
| ABS | 0.41 | 0.18 | -0.61 | NA | NA | 0.88 |
| AST | | | | | | |
| Pc agricultural assets | 0.77 | 0.12 | 0.04 | NA | NA | 0.95 |
| pc non -farm business assets | 0.29 | -0.22 | 0.11 | NA | NA | 0.65 |
| Pc wealth Index | 0.38 | 0.23 | 0.08 | NA | NA | 0.81 |
| Pc Tropical Livestock Unit | 0.42 | 0.18 | -0.08 | NA | NA | 0.93 |
| AC | | | | | | |
| Participation index | 0.63 | 0.21 | 0.08 | NA | NA | 0.92 |
| HH average years of education | 0.21 | 0.34 | 0.22 | NA | NA | 0.71 |
| Dependency ratio | 0.45 | 0.18 | -0.23 | NA | NA | 0.94 |
| diversity of income sources | 0.55 | 0.44 | 0.67 | NA | NA | 0.88 |
| SSN | | | | | | |
| transfers (naira) | 0.65 | 0.34 | 0.19 | NA | NA | 0.92 |
| other transfers (naira) | 0.54 | -0.45 | 0.33 | NA | NA | 0.87 |
| scholarship (yes or no) | -0.46 | 0.37 | 0.26 | NA | NA | 0.66 |
| Has a migrant (yes or no) | 0.66 | 0.4 | 0.24 | NA | NA | 0.95 |
| ABS | | | | | | |
| Infrastructure index | 0.49 | 0.18 | -0.15 | 0.34 | 0.46 | 0.93 |
| Distance to primary school (km) | 0.22 | 0.38 | -0.32 | 0.33 | 0.37 | 0.68 |
| Distance to secondary school (km) | 0.39 | 0.45 | 0.11 | 0.45 | -0.11 | 0.74 |
| Distance from health services (km) | 0.64 | 0.35 | -0.22 | 0.39 | -0.44 | 0.95 |
| Distance to market (km) | 0.77 | 0.41 | 0.44 | 0.29 | 0.11 | 0.96 |
| Distance to major road (km) | 0.34 | 0.53 | 0.27 | 0.31 | 0.25 | 0.82 |
| notes: NA obtains when indicated factor number does not apply to component | | | | | | |